# SCIENTIFIC AMERICAN

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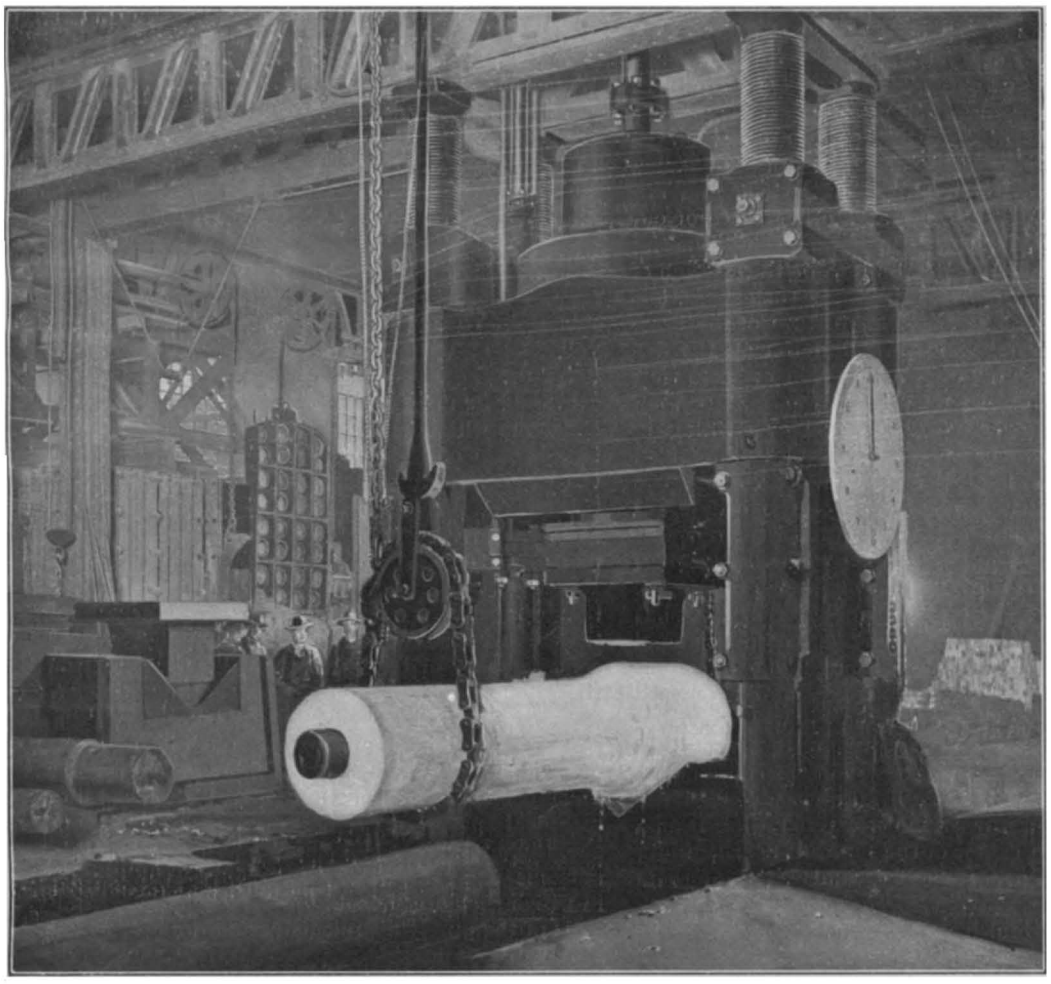
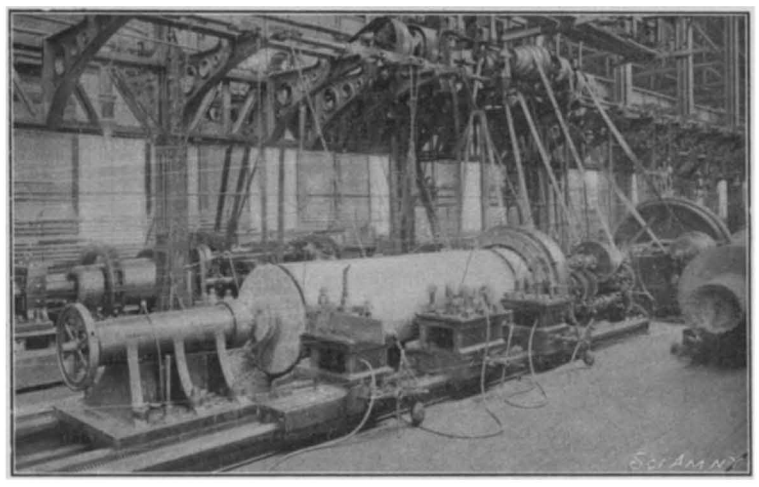
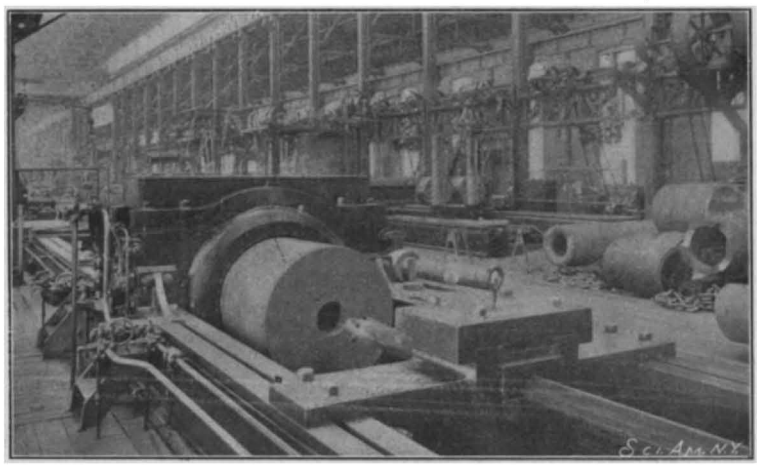


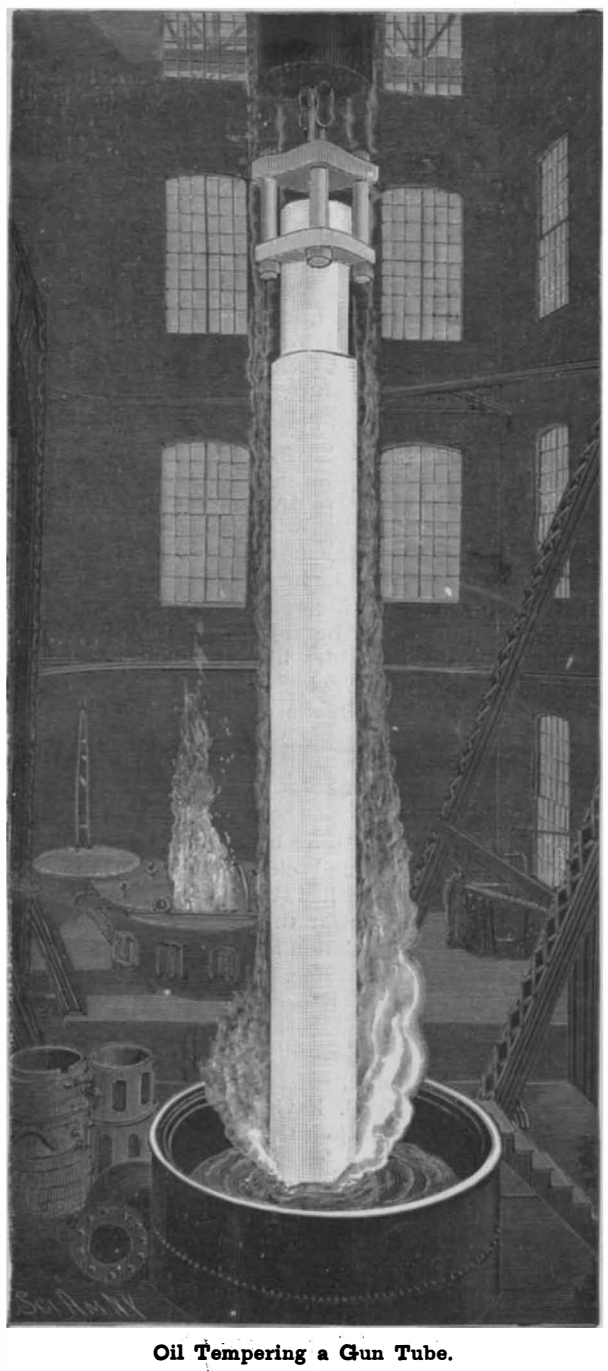
Hollow-Forging a Gun-Tube in the 5,000-Ton Press.



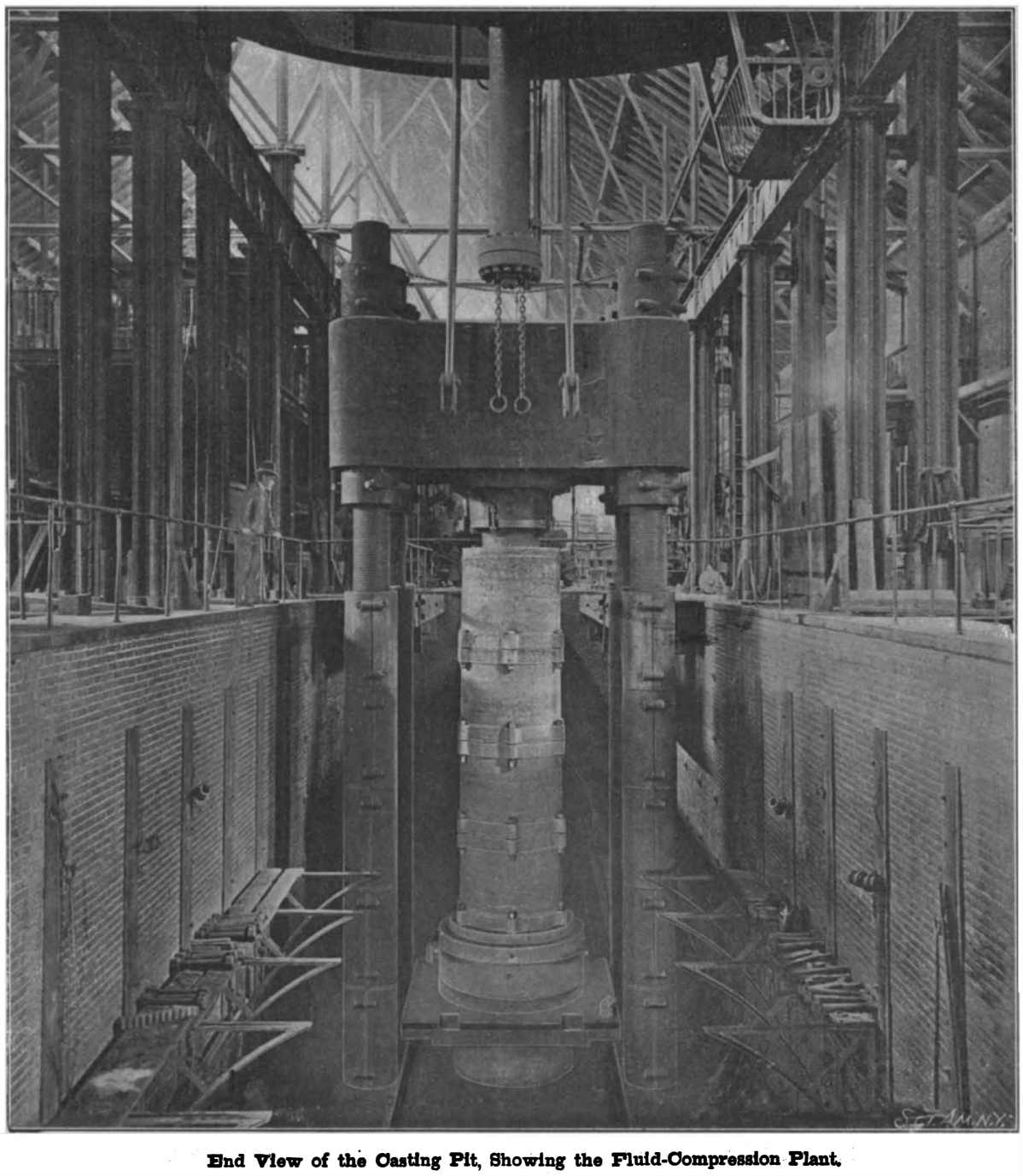
Cutting Fluid-Compressed Ingot into Blocks.



Boring a Fluid-Compressed Ingot Preparatory to Forging.

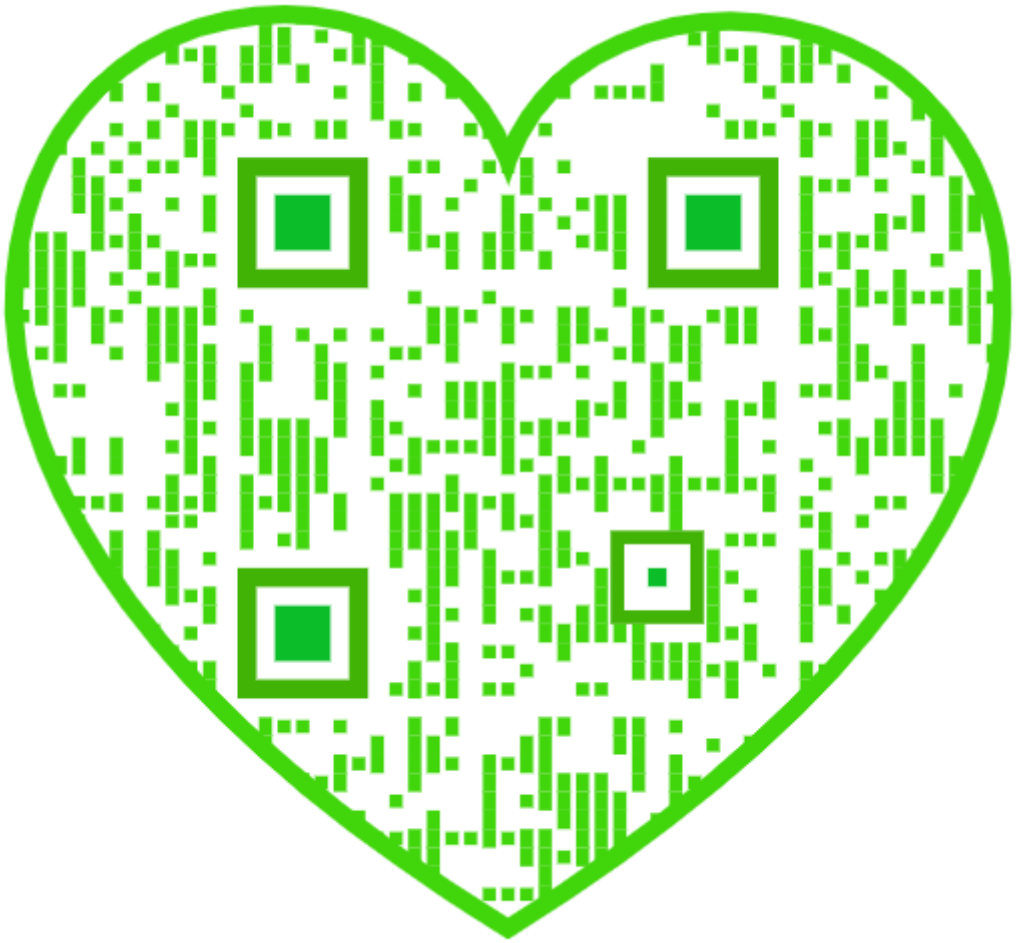


Oil Tempering a Gun Tube.



End View of the Casting Pit, Showing the Fluid-Compression Plant.

MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS—II. FLUID COMPRESSION AND FORGING.—[See page 358.]



# Scientific American.

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## ATMOSPHERIC RESISTANCE TO RAILROAD TRAINS.

In our issue of July 15, of last year, we illustrated and commented at considerable length upon the remarkable speed of over sixty-two miles made by a bicyclist paced by a locomotive over a mile of measured track. In speaking of the lessons in air-resistance taught by this performance, we referred to the proposal of Mr. F. U. Adams to sheathe a railroad train, and give it a cross-section similar to the shield used in this bicycle trial—this with a view to proving the correctness of his theory that atmospheric resistance could be greatly reduced, and the speed proportionately increased, by building a train with something of the wedge-shaped ends and smooth and continuous lines that characterize the models of steamships.

Thanks to the enterprise of the Baltimore and Ohio Railroad, a full-sized train has been equipped on the lines suggested, and a series of trials is now being made under working conditions, and under a system of chronometer timings which should preclude all possibility of error. On another page will be found an illustration of the train and an account of the trial run of forty miles between Baltimore and Washington. We are free to confess that, unless there has been some error in the timing or the distances, the results are without a parallel, and may be taken as establishing a record in high-speed railroad travel.

While it is true that forty miles has, on other occasions, been run at a higher average speed than sixty-four miles an hour, the record has never been made under such unfavorable circumstances. The present run was made from start to stop with one slow-down to twenty miles an hour, and the line, on account of its grades and curvature, is not to be compared with the straight and level stretches of track over which phenomenal speeds have been hitherto attained.

The most surprising records on this trial (which are such as may well strain the credulity of railroad men) were obtained over the 20·1 miles from Annapolis Junction to Trinidad, which were covered at the rate of 78·6 miles an hour. This would be a remarkable performance for a 57-ton engine if it were hauling a train of 170 tons over a level road; but when we bear in mind that the first 7 miles was on an up-grade of from 25 to 55 feet to the mile, and that to maintain the high average the last 5 miles of downgrade was run at the rate of 102·8 miles per hour, it is evident that some abnormal conditions must have been present to render such a feat possible. There is no authentic record of such a speed having been attained, even for one mile; for although a speed of 112 miles an hour was claimed to have been made by the Empire State Express, the officials of the New York Central Road have rejected the record as being doubtful.

It has been pointed out by Mr. Rous-Martin, who spends most of his time upon the footplate of express engines, and is the accepted authority on the subject, that a liberal percentage must be deducted from most of the so-called record speeds of trains (particularly where the distances are a mile or less than a mile in length), because an error of a very small fraction in the timing will make a very large error in the estimated speed per hour. We are informed by Mr. Adams that error was guarded against in the case of the Baltimore and Ohio train, by providing five timekeepers and taking the average of the times recorded by the stop watches as each station was passed. There was a close agreement between the watches as to the time occupied in running from Alexander Junction to Trinidad, and if the distance is, as stated, exactly five miles, the record of over 100 miles an hour must be taken as established.

The results of this most interesting experiment are not so surprising, if we bear in mind what the windshield has done for the bicyclist. The fastest riders can barely cover a mile, unpaced, in two minutes; but with a moto-cycle to pace him a rider has made the distance in one minute and nineteen seconds, and behind the more complete shelter of a locomotive and car the mile has been done in fifty-seven and four-fifths seconds. It is natural to suppose that by smoothing out the train, as it were, and preventing the air from closing in upon platforms and trucks, a proportionate increase of speed would be realized. At the same time it cannot be denied that the results are so unprecedented as to lend extraordinary interest to the trials which have yet to be made.

## THE TOTAL ECLIPSE OF THE SUN.

It is safe to say that the total eclipse of the sun of May 28, 1900, has attracted more attention, at least in the United States, and been more widely observed by both professionals and amateurs, than any previous eclipse. The increasing interest in this always instructive phenomenon and the great improvement in the modern instruments for taking accurate observations account for much of this, but the main and controlling reason was the convenient locality of the moon's shadow on the surface of the earth, generally known as the path of the eclipse. This path extended in an almost straight line about 50 miles in width from the southeastern part of Louisiana to the capes of the Chesapeake, passing over portions of Louisiana, Alabama, Georgia, North and South Carolina and Virginia, including New Orleans and other cities of our Southern States. This location of the path of the sun not only afforded to the inhabitants of this section of the country an easy opportunity to see the eclipse, but made excursion parties a special feature of the occasion, and the President left Washington on the dispatch boat "Dolphin" with a party in order to view the eclipse near Norfolk, Va.

There was, however, nothing novel or striking in the general nature of the eclipse, and it resembled in many respects its immediate predecessors. The corona was very similar to those of the eclipses of 1878 and 1889, and like them extended on one side of the sun in the shape of a long pointed streamer, and on the other side like an enormous fish tail, in the extreme end of which was the planet Mercury. It has also been described as consisting of three principal streamers of about equal length, and one of about half the length of the other three, and of curved rays from the poles of the sun, which were very conspicuous. Another observer says that he saw fifteen streamers in the north polar region of the sun, of even and regular structure, with bright centers. In the south polar region the streamers were rolling from a point not near the center of the sun, but near its limb, and were of a finer structure, and some of them crossed.

The corona was bluish green in color, and some described it as having a silvery hue. The solar prominences or the chromosphere, instead of the usual carmine or light crimson, was remarkable for being light pink, which, according to Prof. Eastman, is a very unusual thing.

One reason given for the great similarity of the corona in the eclipses of 1878, 1889 and 1900 is the fact that these years were all years of minimum sun spots, and it is supposed to bear out the theory that a relation exists between the sun spots and the corona.

But while the corona was a beautiful and awe-inspiring sight, it was not considered to have equaled its predecessors. It was fainter than in 1878 and dimmer than usual; the prominent white places were entirely wanting and the streamers were not quite as active as formerly.

## SCIENTIFIC TRANSLATION.

Glancing over the list of scientific books which are published each year in ever increasing numbers, one finds that not a few of them are translations of German and French works, which have been deemed of sufficient importance and value to warrant a reissue in England or the United States. The introduction to English-speaking scientists of works whose writers are respected as authorities is undeniably praiseworthy; but the ragged English in which the thoughts of these foreign authors have been clothed must give us pause and cause us to reflect whether engineers and chemists would not do well to brush up their German and French, mildewed by long disuse, and to read in their undefiled native language those works which are now presented in uncouth dress.

The translation of a scientific treatise is both more difficult and more readily accomplished than the translation of a novel or essay; more difficult because it requires in addition to a mastery of two languages, a reasonably thorough knowledge of the subject under discussion; more readily accomplished because elegance of expression must give place to accuracy of translation. Indeed, exactness is the prime requisite of a rendering of a foreign scientific work.

But sometimes it happens that a scientific writer is not only a man of thought, but also a man of considerable literary ability, who clothes his thought in phrases and sentences artistically formed and grouped. The translation of the writings of such a man, ceases to be merely an intellectual task; it becomes an undertaking in which the feeling and good taste of the translator are called into requisition to reproduce as faithfully as possible the style as well as the intellectual traits of the original. A Frenchman, who would construe into his mother-tongue the lectures of Huxley and Tyndall, would seek to convey in his version something more than the mere thought of his original. He would endeavor to reflect the style as well—not that he would ever fully succeed, for the idiomatic grace of one language can never find an exact counterpart in another; but he would deem it necessary to convey to his readers something of the color, the music, and the suggestiveness of the English work. In short, he would attempt to reproduce the man, even to his mannerisms, as well as the thought of the man.

That most scientific translators fail to catch the style of the foreign author is too often due to a deficient knowledge of their own language. A well-known and most successful translator of novels, a woman who has presented to Americans many of the most popular works of German fiction, once remarked: "Anybody can find out the meaning of a French and German text; that is simply a matter of using a grammar and a dictionary. The secret of making an acceptable translation lies in the ability to express that meaning in good English."

But granting that the dictionary is a matter of secondary importance to the translator of novels, it can not be denied that it is well-nigh indispensable to the man who is rendering into English the works of a foreign scientist. As the late Master of Balliol was wont to say, no one is infallible,—not even the youngest of us. No translator can be expected to know the English equivalent of every foreign technical term; he must of necessity have recourse to a good lexicon in which he is sure to find reasonably accurate translations of technical phrases. But unfortunately the dictionaries at present in use are most dangerous things. That they are for the most part old is pardonable; but that their definitions should often be inadequate and sometimes inaccurate is inexcusable.

Few works become so quickly antiquated as scientific dictionaries. An invention frequently requires the coining of an entire terminology to define the new contrivance and its functions. The introduction of the phonograph and telephone, the invention of the steam engine and dynamo-electric machine, the discovery of the Roentgen rays, have each been the means of enriching our scientific vocabulary with words that have been immediately seized and absorbed in the technical speech of the day. Although of new mintage, these terms are as commonly used as any in ordinary mechanical parlance. Obviously the dictionary in which they are not contained is incomplete. And yet most of the purely technical dictionaries are so lamentably deficient in this respect that, for example, many of the terms used in electrical engineering for the last fifteen years, find no place in their pages. For this reason the task of the scientific translator is rendered doubly difficult. In order faithfully to render a scientific treatise into English he must, in a measure, be independent of the lexicon; he must be sufficiently conversant with the topic under discussion to supply, when his dictionary fails him, a correct translation of a term, and to select from a number of meanings that which adequately fills his needs. We shall not readily forget a translation of an article on a German airship, published in a prominent American newspaper, in which the German word for "car" (Gondel) was literally translated by "Gondola," an example either of a too slavish adherence to the original or a lack of judgment on the part of the translator.

The habit of consulting a good technical dictionary is one of the means of cultivating a nice appreciation of distinctions in scientific synonyms. One acquires, moreover, an excellent understanding of the possibilities of one's mother tongue as well as a knowledge of its defects and of its advantages over other languages. The English translator will tell you that, of all languages, French is the most idiomatic; German the least. And although he has not the blessed German privilege of compounding words *ad libitum* to meet his special requirements, he rejoices in that wealth of synonyms which enables him to render a foreign sentence into good Anglo-Saxon with much of its original vigor and idiomatic connotation, and to give to his translation all the marks of an English work, with no trace whatever of the foreign idiom.

## THE CENTRAL LONDON TUNNEL ROAD.

A number of details have been recently published as to the new underground electric railway of London. This road, which is called the Central London, commences in the city, near the Bank of England, at a point where the circulation is greatest; it traverses the city in a nearly straight line, its route following mainly Holborn and Oxford Street, ending at Shepherd's Bush, not far from the Uxbridge Station of the Metropolitan; it has 12 intermediate stations. The line is formed of two tunnels, with metallic lining, at 80 feet below the street level, having an interior diameter of 11 feet. At the stations the tunnels are enlarged to 20 feet diameter over a length 370 feet. The stations are reached from above by three pits; one of these is 18 feet in diameter, and has a spiral staircase, the two others, of 23 feet diameter, being each provided with two electric elevators, these having a capacity of 100 persons each. The tracks of the road are laid with steel rails of 100 lb. to the yard; a third rail placed in the center serves to bring the current for the motors.

The road now has 32 locomotives, and the trains are made up of 7 cars, carrying 336 passengers. The weight of the train, without locomotive, is 105 tons, the latter weighing 42 tons. The average speed is 14 miles per hour, with stops of 20 seconds at the stations; a maximum speed of 30 miles is allowed. The trains follow each other at intervals of 2½ minutes, and this is reduced to 2 minutes at times of greatest traffic.

The profile of the road presents the peculiarity that each station occupies a level between two grades, ascending and descending, of 3 per cent. This gives a diminution of speed upon arriving, and on the other hand makes it easier to start the motors on leaving the station; this arrangement gives a considerable economy of current. The central station is located at Shepherd's Bush, and supplies three-phase current at a tension of 5,000 volts; this is transformed in four sub-stations to continuous current at 500 volts for the motors. The locomotives have two trucks, each of which is provided with two motors. The current is taken by rubbing contacts upon the central rail. The annual expenses of operation are estimated at $660,000, this being made on a basis of 2½ minute intervals for the trains.

## SMELTING PROCESS FOR ZINC ORES.

The zinc industry has been brought prominently before the public by the promotion of many companies to operate the rich mines of the Joplin district of Missouri and Arkansas, a profitable state of affairs having resulted from the ore producers' combining and dictating prices to the smelters. It happens that the Joplin mines produce over 60 per cent of the world's output of zinc ores which can be reduced economically by present methods. From the standpoint of scientific smelting, zinc occupies a most unsatisfactory position. The reduction of its ores is accomplished by processes "just as clumsy as they were when Paracelsus described them more than three hundred years ago." Arthur Winslow states in an article upon the lead and zinc industry of Missouri, that in making zinc upon a large scale about 25 to 30 per cent of the metal is lost, and that it takes 3 tons of ore averaging from 45 to 50 per cent of zinc, 6 tons of coal, and 700 pounds of refractory materials to yield 1 ton of zinc. The present methods require rich ores which are first roasted to transform their zinc compounds into oxide. The calcined ore is mixed with coal and loaded in small charges into clay retorts which are placed, many at a time, in a special furnace. Upon heating, the zinc is produced and volatilized, the vapors being led to condensing apparatus by suitable connections with the retorts. This laboratory method has to be employed because the temperature of reduction of zinc oxide and the boiling-point of zinc at atmospheric pressure differ by but a few degrees. Many endeavors to produce zinc, like iron, lead, and copper, in a blast-furnace have failed, the metal being vaporized and lost with the gases as zinc dust, a mixture of zinc oxide and finely divided zinc.

There exist throughout the West unlimited deposits of sulphureted zinc-lead ores, carrying generally a small amount of silver. They are cheap but refractory. An easily available ore of this nature contains 20 per cent lead, 30 per cent zinc, and 40 ounces of silver per ton. At the present day these ores are utilized by the lead smelters. In the ordinary way of lead smelting rich ores are required. These being rare and the competition keen, the smelter has to purchase them at prices not only leaving no profit but mostly entailing actual loss. To counterbalance this loss there is included in the furnace charges as much of the cheap, refactory ores as can safely be added. Yet, in the present method of smelting, not only is the whole of the zinc lost, but its very presence causes great losses of lead, silver, and gold, partly due to the formation of flue dust and partly by the production of a viscous slag rich in zinc. In purchasing these ores the smelter does not pay for the zinc and deducts, moreover, 50 cents per ton from the price established by the amount of lead and precious metals for each per cent of zinc above 10. As the zinc passing into the slag renders them very viscous, the smelter can only add as much as is compatible with economy. It is not good practice to have more than 7 per cent of zinc in the slag. On this basis the quantity of zinc lost in slag in the United States amounts to more than its total annual production.

Dr. Emil E. Lungwitz, a mining engineer of considerable experience, has invented a process for the smelting of these refractory ores and the recovery of practically all the contained metals. It merits attention because it rests upon a sound, scientific foundation, and the facts involved have been established by careful experiments made in the laboratory of the Royal Polytechnic School of Berlin by Dr. Lungwitz and Dr. R. C. Schüpphaus. The process is based upon the fact that the boiling point of a liquid is an increasing function of the pressure. Dr. Karl Barus has determined the most reliable figures with regard to zinc, and states that in the neighborhood of atmospheric pressure, the temperature increment of the boiling point of zinc amounts to 1·5° C. for each additional centimeter of mercury pressure. Briefly, Dr. Lungwitz proposes to smelt zinc ores in a blast furnace under pressure sufficient to keep the zinc liquid at the temperature of the furnace and to withdraw it in such a manner that it will have a temperature below its boiling point under atmospheric pressure when it reaches the receiving vessels. The objection occurs at once that bulky constructions like blast furnaces do not lend themselves to designs involving high internal pressures. Dr. Lungwitz, however, is convinced that a pressure of three atmospheres is amply sufficient. The facts to support this are: The temperature of reduction of zinc oxide by carbon is 910° C., and the boiling point of zinc under one atmosphere is 930° C. Dr. Barus estimates the boiling point of zinc under five atmospheres pressure to be 1,500° C., a temperature known to be entirely out of the question for the melting of either lead or zinc ores or a mixture of both. The temperature of a slag formed in a lead stack was found by Malvern Iles to be 1,034° C. The melting point of diabase is not higher than 1,170° C., according to Dr. Barus, and no blast furnace could ever be run on a slag of similar composition. In the experiments of Dr. Lungwitz and Dr. Schüpphaus, a crucible supported and surrounded by fireclay bricks was placed in a strong cast-iron vessel provided with a bolted cover. The high temperatures needed were obtained by heating to incandescence by an electric current a platinum wire strung up and down through perforated rims on the inside of the fireclay cylinder into which the crucible fitted. Temperature measurements were made with a Le Chatelier thermo-couple carried in a porcelain tube dipping down into the top of the crucible. Pressures were obtained by forcing air in by a small compressor. A gage and safety valve were also attached. There were obtained in this apparatus ingots of zinc at the bottom of the crucible when a mixture of pure zinc oxide and carbon was heated under a gage pressure of 45 pounds per square inch to 1,150° C., a temperature some 200° C. above the ordinary boiling point of zinc.

Conditions are yet more favorable in smelting the sulphureted zinc lead ores. Taking the temperature of lead furnace at 1,056° C., the tension of zinc vapor for that temperature is under two atmospheres, as given by the figures of Dr. Barus. In addition, lead and zinc alloy with avidity at red heat and the osmotic pressure exerted under these conditions will aid to prevent the ebullition of the zinc. The separation of these metals is most easily effected by cooling, for at temperatures in the neighborhood of the melting point of zinc (415° C.), lead combines with but a few tenths of one per cent of zinc, no matter how carefully the mixture is stirred. These facts show the feasibility of Dr. Lungwitz's process and prove that the conditions of operation will lie entirely within practical bounds.

There have been experiences in smelting work which show that the accidental establishment of these conditions has led to the delivery of zinc in small quantities, when zinciferous ores have been made use of. The Rammelsberg smelters, in the Hartz Mountains, sold, forty years ago, zinc that had been tapped from lead blast furnaces, the quantity obtained at each tapping varying from 0·5 to 5 pounds. Then an improvement called the zinc shelf was introduced to condense the zinc vapors, and what was obtained was found very rich in lead and was produced under the conditions of a reducing atmosphere, at a low temperature as compared with modern practice, and under a slight excess of pressure. The New Jersey Zinc and Iron Company utilize a zinciferous iron ore by first vaporizing and oxidizing the zinc and then smelting the residues from iron. These residues contain at least 3 per cent zinc, and it frequently happens that when the furnace cools off considerably and the pressure of the blast rises, establishing conditions favorable to the formation of liquid zinc, quantities of from 400 to 500 pounds of metallic zinc have been tapped together with the iron. These and similar observations were investigated carefully by Dr. Lungwitz, and he concludes: "From these actually observed cases of condensation of zinc in blast furnaces, under widely differing conditions, we may conclude that the forces favorable to the liquefaction of the zinc are pressure in the furnace and chemical affinity."

Dr. Lungwitz has proved his case up to the point of actual trial in a large furnace. This will be done before the year is out. It is expected that no flue-dust will be formed during the trial, by reason of the high-pressure blast which will be employed.

An interesting chemical point in connection with the experiments of Dr. Lungwitz and Dr. Schüpphaus in their laboratory furnace was the formation on different occasions of a powder of a canary-yellow hue which contained by chemical analysis more zinc than belongs to ZnO. Pursuing the idea that this yellow compound might be a low oxide of zinc, they made the following experiments, each yielding a body permanently yellow. Zinc oxide was heated in an atmosphere of pure nitrogen; zinc oxide was heated in vacuo; zinc oxide mixed with zinc dust was heated under pressure. The investigators concluded: "These experiments render it highly probable that zinc oxide on heating loses part of its oxygen and that the new compound is stable if it is cooled in the absence of oxygen." The matter is being thoroughly investigated by Prof. v. Knorre, of the Berlin Polytechnic School.

## A NEW TELE-PHOTO LENS.

Although the tele-photo lens has been before photographers for about ten years it has not come into anything like general use or acquired the popularity that it deserves. Two causes have contributed to this: the general belief, derived from its name, that it is only adapted to photography at long distances, and the fact that with the tele attachment, very much longer exposures are necessary than with the normal lens without it.

All this is now likely to be changed and the tele-photo lens given a fresh start, T. R. Dallmeyer having patented an arrangement in which the complete enlarging system may be as fast as the ordinary lens alone, and the users of hand and other small cameras may avoid the usual "exaggerated perspective" by getting at a greater distance from the foregrounds, and at the same time secure any desired size of image.

The new tele attachment consists of two lenses, a positive and a negative, one in each end of a sliding tube, and placed in front of the ordinary lens, generally screwed into the place of the hood. The outer or positive lens is of the highest possible intensity, that is, of as large a diameter and short focus as may be convenient; the inner or negative should be of shorter focus than the ordinary lens, and its power should be at least equal to the sum of both.

When the lenses of the tele attachment are at their normal distance apart, that is at a distance equal to the difference of their focal lengths, parallel rays incident on the outer or convergent lens are sent converging to the inner, the diverging, and by it transmitted parallel to the ordinary lens. If this has been focused for parallel rays, as is the case with so-called "fixed focus" cameras, the image of the complete system will be formed at its focal plane, just where it would be without the tele attachment, but with considerable magnification.

Placed more closely together, the converging rays from the positive lens are, by the negative, transmitted to the ordinary lens at an increased degree of divergence, forming a larger image, larger in proportion to the decrease of the distance, but coming to a focus at varying distances beyond its focal plane.

When the elements of the tele arrangement are separated to distances beyond their normal, their action is reversed; rays reach the ordinary lens in a convergent form and come to a focus within its focal plane; but the intensity is considerably increased, that is, the system now is faster than the ordinary lens without the tele arrangement.

In connection with this, it may be interesting to know that not to Barlow, in 1834, as is generally supposed, are we indebted for the original tele-photo lens, but to R. P. F. Joannis Zahn, in 1686. Dr. Von Rohr tells The British Journal of Photography that he recently unearthed a book by that old scientist, in which he describes and illustrates "A special combination of a concave and convex lens for producing a larger image," and drawing and description are as applicable to the modern tele-photographic lens as though they had been made yesterday; the only difference being that his lenses were not corrected, while those of the modern instrument are.

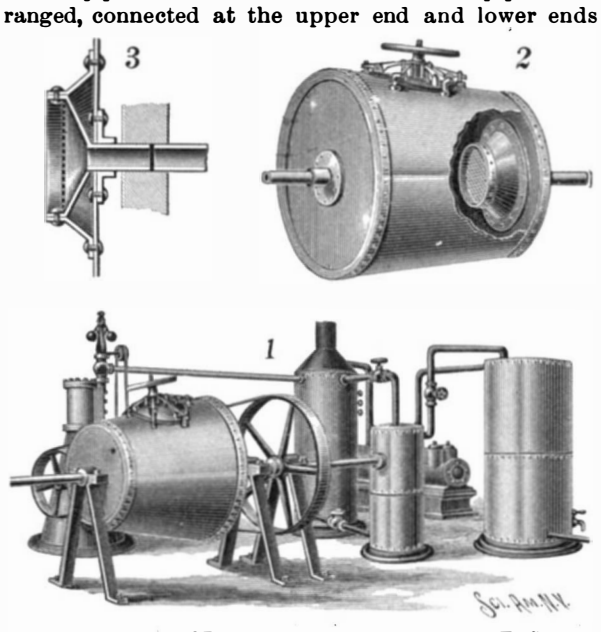
## THE LATEST DEVELOPER.

A new developer has lately appeared which is said to give good results and the equal, if not superior, to hydroquinone. The body which has received the name of adurol is a derivative of hydroquinone, and seems to have all the good properties of that developer, without its defects. It requires but a small quantity of alkali, and the potassium carbonate may thus be replaced by sodium carbonate, which is less corrosive, while the use of caustic alkali becomes necessary. In spite of the small quantity of alkali, the image comes up more quickly than with hydroquinone, and it is also to be remarked that low temperatures have no appreciable influence in retarding the development of the image or details. The principal quality of adurol is its great developing power, which is not equaled by hydroquinone even with the use of caustic soda; it has the valuable property of working up to the end of the development without causing fog upon the plate, which renders it superior to many other developers in this respect. The image appears normally in about 20 seconds and the development is regular and uniform; after about 4 minutes it has gained the desired intensity. The reduction of silver takes place not only in the strongly exposed parts, but in the details, which come up regularly as the development proceeds; in this way the final results is a plate which presents a harmonious appearance, rather soft than hard in quality. It is apparent that audriol may be used with shorter exposures then when hydrochinon is used, and may thus be of value for exposures by dim light, for rapid instantaneous work, X-ray exposures, etc. Bromide of potassium is an excellent retarder for this developer, but it may be used in smaller proportion than usual.

### AN IMPROVEMENT IN DRIERS.

An invention has been patented by Mr. John Waterhouse, a consulting engineer of 71 Broadway, Manhattan, New York city, which provides a machine for drying meats, fruits, sand, and earthy matter containing precious metals or stones, by the use of heated compressed air.

Mr. Waterhouse employs an air-compressor which forces air to a receiver, water-jacketed to condense the moisture in the air. This dried air is passed through a valved pipe to a reheater in which a coiled pipe is arranged, connected at the upper end and lower ends




A DRIER FOR MEATS, SAND, FRUITS, ETC.

with a boiler, so that steam is constantly received from and returned to the boiler. After having been heated in its passage about the steam-coil, the air is conducted through a pipe connected with a tapered tumbler. As shown in Figs. 2 and 3, the tumbler is provided with hollow journals, one of which is connected with the pipe leading from the reheater and the other of which is joined to a discharge-pipe. In the smaller end of the tumbler is a funnel provided with a sieve. The material to be dried is poured into the tumbler through an opening which is closed by an air-tight cover held firmly in place by means of levers coacting with a handwheel. The tumbler is rotated by a driving-pulley connected by a belt with an engine. The boiler used for supplying steam to the heating coil drives this engine as well as the air-compressor.

The dry, heated air from the reheater enters the tumbler, absorbs the moisture in the material to be dried, carries it through the funnel-screen, and into the discharge-pipe. When ore-bearing sands are to be tried, and the moisture has been sufficiently removed, the earth and fine sand are blown out, leaving the heavier metal behind. The drier, it is evident, can be used in removing the moisture from almost every kind of material.

### EXPERIMENTAL TRAIN FOR TESTING ATMOSPHERIC RESISTANCE.

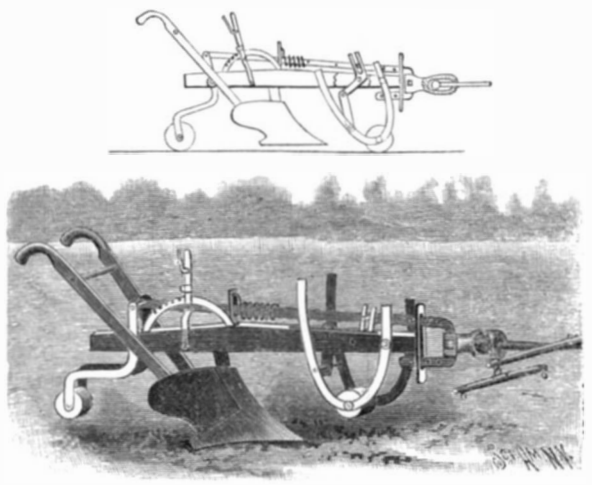
The Baltimore and Ohio Railroad Company is engaged in a series of experiments upon the atmospheric resistance to railroad trains, which cannot fail to throw considerable light upon a little understood and too much neglected problem. The special train of six cars shown in our illustration has been "sheathed" and otherwise altered, under the plans and directions of Frederick U. Adams, and on Saturday, May 26, it made an experimental run from Baltimore to Washington, which in respect of speeds attained, relative to the grades and curvatures and the relative weight of engine to train, is the most remarkable on record.

The Adams theory of train resistance has been explained and a description of his train given in previous numbers of the SCIENTIFIC AMERICAN. Briefly stated, Mr. Adams contends that the pressure of the atmosphere, due to the speed of the train, constitutes the greatest form of resistance at all velocities exceeding forty miles an hour, and that this friction steadily increases as the square of the velocity. The sheathed train is built with the view to reduce the number of surfaces and projections, such as car ends, trucks, ventilators, etc., which serve to hold the air and oppose the free passage of the train through the atmosphere. It is argued that after the locomotive has opened up a path, as it were, for the train, the roof and sides of the latter should be as smooth and continuous as possible, with a view to reducing what might be called the "skin-friction" to a minimum, the train sheltering behind the engine as a bicyclist behind his pacing machine. The trial train is made up of six passenger coaches, such as are used on suburban service. They are provided with four-wheeled trucks, 33-inch cast iron wheels and 3¾-inch journals—not an ideal equipment as compared with the standard six-wheeled truck, with 36-inch turned wheels with axles running on 4¾-inch journals. The total weight of the train, exclusive of engine and tender, was 325,500 pounds. With the passengers carried on the Baltimore-Washington test, the weight of the train was about 170 tons.

In preparation for the test all external obstructions have been removed from the train. The roofs of the cars are arched; the windows set out flush with the sides of the cars; and the sheathing is laid lengthwise instead of perpendicular as in other cars. The sheathing extends down to within eight inches of the track and completely houses the trucks. Suitable openings permit access to the axle boxes, and a sliding door leads into the substructure at opposite sides of the car center. When the cars are coupled, two diaphragms meet and inclose the space between the cars, from edge to edge of the roof line. The platform doors consist of roller curtains which drop to the steps and are flush with the sides. Flexible spring curtains complete the vestibule from the roof to the bottom of the car. When the train is coupled, it presents the appearance of one long, sinuous and flexible car. The tender is of peculiar construction, and continues the unbroken line from the engine cab to the baggage car, to which it is vestibuled. In its entire construction the train complies with the varied demands of practical operation. While the plans call for the partial sheathing of the locomotive, it was decided to make the first tests with remodeled cars only, in order to prove how far the existing system of car construction is responsible for the atmospheric resistance of trains.

It is 40 miles from Camden Station, Baltimore, to the depot sheds at Washington. For two miles out of Baltimore the curves and switches and the city ordinances prescribe a low speed. The same is true of the two miles into Washington. At Relay, nine miles from Baltimore, there is a curved viaduct which must be crossed at a speed not exceeding 20 miles an hour. For the entire distance there is no tangent equal to 2½ miles in length. The road-bed is in first-class condition, but the conditions named should prevent any phenomenal running. The best time which had previously been made on this line was a few seconds less than 39 minutes, on which occasion the train consisted of four Pullman cars hauled by engine No. 1313, weight about 85 tons, carrying 190 pounds of steam, and rated as the fastest and most powerful passenger engine belonging to the company. The time was taken from a running start at May Street, and very fast time was made through the city limits.

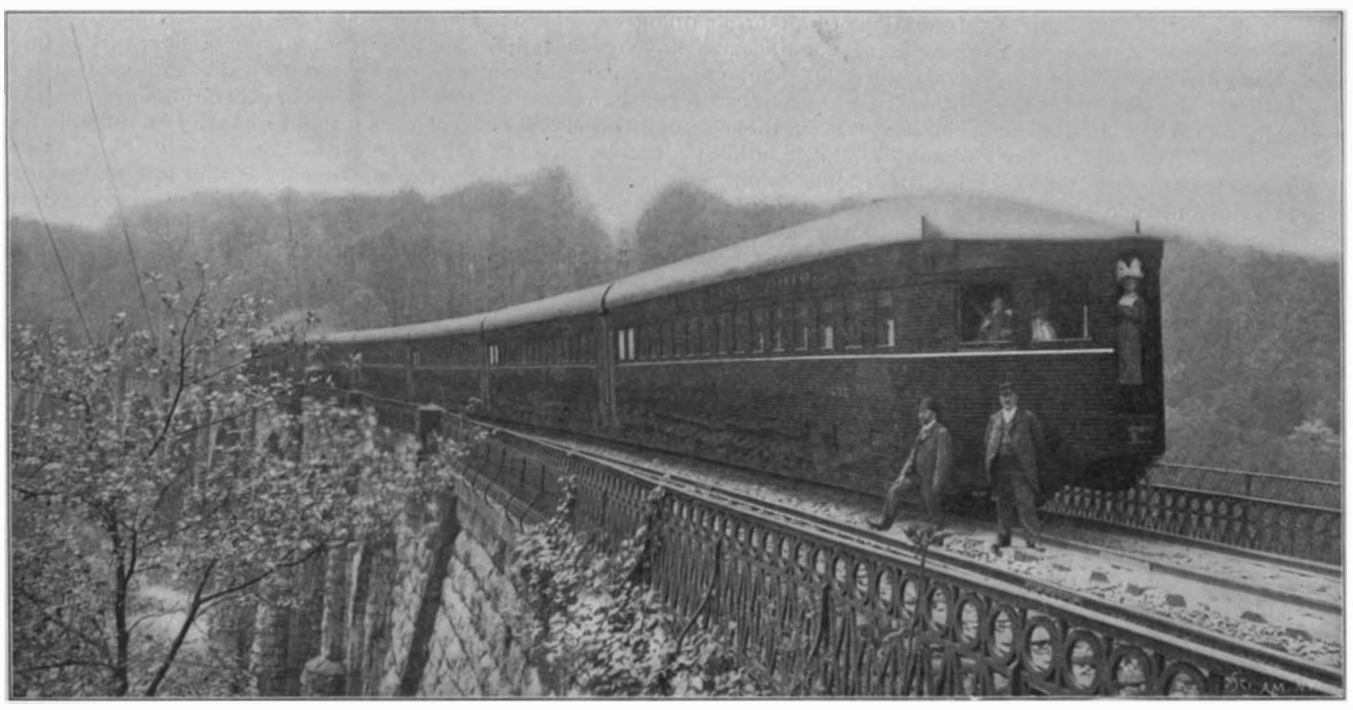
The sheathed train, consisting of six cars and hauled by an engine weighing 57 tons, made this run in 37 minutes and 30 seconds. One mile was made in 40 seconds, and two miles in 81 seconds. From Beltville



JONES' PLOW.

to College, a distance of 4½ miles, the time was 3 minutes and 10 seconds, a sustained speed of 85 miles an hour. By far the most remarkable run, however, was from Annapolis Junction to Trinidad, a distance of 20·1 miles in 15 minutes and 20 seconds, at an average speed of 78·6 miles an hour. The first seven miles of this run was up a grade of from 25 to 55 feet to the mile, and it was covered in a fraction over 6 minutes; while the last 5 miles on the down grade from Alexander Junction to Trinidad was covered in 2 minutes and 55 seconds, a speed of 102·8 miles an hour. The locomotive has cylinders 20×24, with four coupled 78-inch drivers. The boiler carried 165 pounds of steam. With ordinary firing the steam never dropped below 160 pounds during the entire run.

SHEATHING AND VESTIBULE CONNECTION OF TENDER



EXPERIMENTAL SHEATHED TRAIN FOR TESTING THE ATMOSPHERIC RESISTANCE.

### NEW PLOW ATTACHMENT.

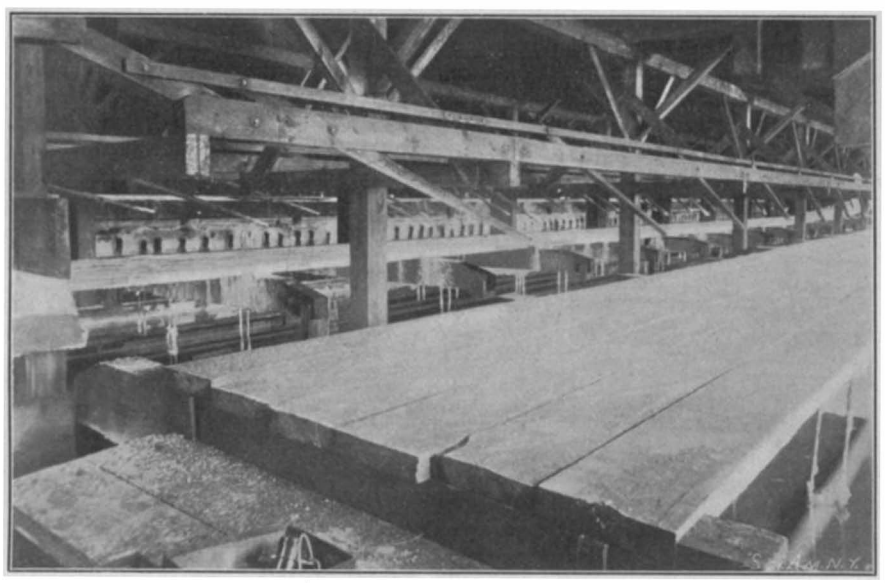
To prevent a plow from jumping out of a furrow, Mr. John E. Jones, of North Bridgewater, N. Y., has devised the attachment pictured in the accompanying engraving. The attachment comprises a frame having two U-shaped side pieces, the forward arms of which are pivoted to the plow-beam, and the rear ends of which engage and slide against the sides of the beam. A roller is journaled in these side-pieces. A frame is mounted to swing on the rear portion of the plow-beam, and is likewise provided with a roller. The two frames are simultaneously operated by a draw-bar connected with the frames in the manner shown. A shifting-lever is pivoted to the draw-bar and to the plow-beam to lower the rollers by hand.

The rear roller follows the bottom of the furrow, thus affording more leverage and solidity to the rear end of the plow than usual, and preventing any tendency of the share to jump when the point strikes an obstruction. But should the plow by any means become displaced, the draft-team is merely backed so that the draw-bar is spring-pressed and pushed to the rear, whereby both rollers are lowered, as shown in our small diagram; it is therefore unnecessary to pull the plow back by hand. When it is desired to draw the implement along without plowing, the rollers are lowered by means of the shifting-lever. The depth of the furrow can be regulated by means of the shifting-lever and by adjusting the front end of the draw-bar.

The pole is connected with the draw-bar by a universal joint. The inventor has subjected his plow to very severe tests, with gratifying results.

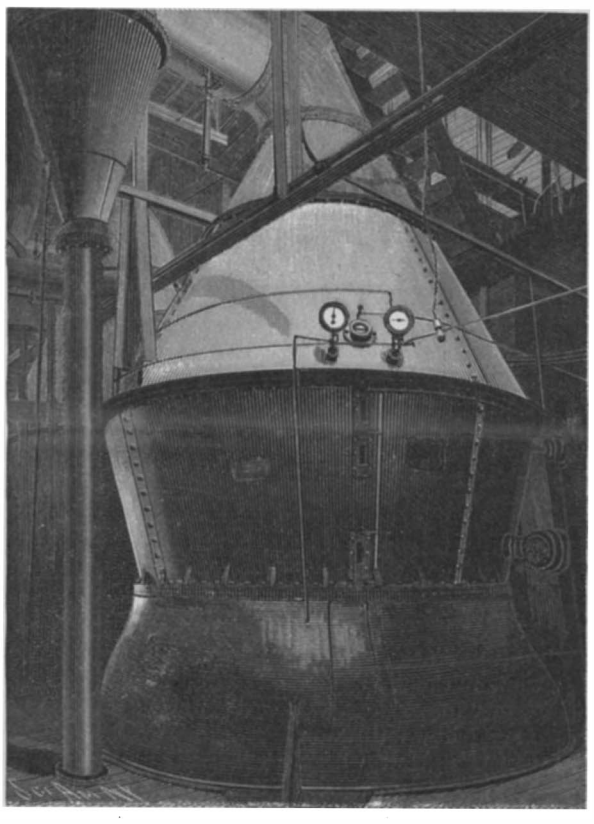
## THE MANUFACTURE OF SALT.

Conspicuous among the natural resources of the State of Michigan are the forests which cover a considerable extent of its surface and the large deposits of salt which underlie a great portion of its area. In the vicinity of Manistee, where the "salt blocks" which form the subject of the present article are located, this deposit consists of a stratum of rock salt, which is from 25 to 30 feet in thickness, and lies some 2,000 feet below the surface. Salt blocks are usually built in connection with sawmill plants, with a view to making use of the refuse as fuel; and for this reason the city of Manistee has of late years become such a large producer of salt that about half of all this commodity manufactured in the State is made at that point.

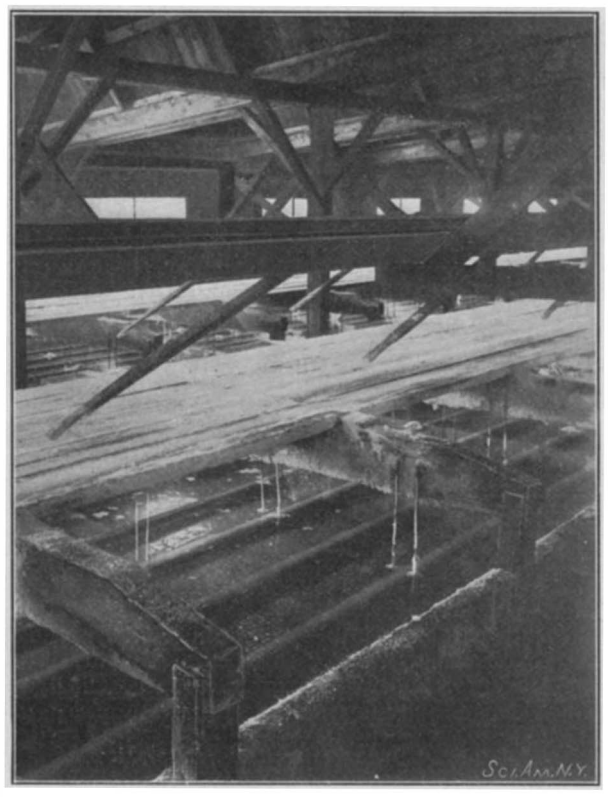


RUNWAY UPON WHICH THE SALT IS SHOVELED FROM THE GRAINER.

As soon as the site of a well has been selected, a cellar is excavated and planked up and a derrick, usually about 80 feet high, is erected and the work of driving commences. The first operation is to sink a section of 10-inch pipe, by means of a sand pump, to a depth of about 400 feet, from which point the well is continued by inserting an 8-inch pipe within the 10-inch pipe and driving it down to the rock formation, the 8-inch pipe extending from the rock up through the 10-inch pipe to the surface of the ground. From the rock formation down, the rock is drilled without any pipe casing, except through such portions as are liable to cave. Salt well No. 5 of the Buckley & Douglas Company's plant at Manistee, which is described in the present article, is fairly typical of the wells in this vicinity. The 10-inch pipe reaches to a depth of 400 feet, the 8-inch pipe to a depth of 616 feet, where the rock formation is encountered. The bed of rock salt, which is 30 feet in thickness, reaches to a depth of 1,985 feet, making a total depth of 2,015 feet. The yield pumped from this well amounts to from 2,000 to 2,400 barrels of brine in twenty-four hours. The same engine, shaft and walking beam used in putting down the wells of this company were formerly utilized to do the pumping, which was accomplished by sucker rods extending down the casing to the pump cylinder in the well pipe. Of late years the air-lift system has been adopted with such good results that 100 per cent more brine is now forced from a well by air than could be raised by the old method. The accompanying diagrams and photographs represent the salt block of the Buckley & Douglas Lumber Company, Manistee, Mich., whose plant is taken as thoroughly representative of the modern state of the art. As the brine is pumped from the well, it is delivered to the storage cisterns, from which it falls by gravity to the settlers, and from the settlers to the grainers. In the settlers it is heated to a temperature of about 170° F. Upon being allowed to cool, the gypsum, which, if it were not removed, would form a coating on the steam pipes in the grainers, is precipitated, and as soon as precipitation is completed the brine is drawn to a long box running across the head ends of the grainers, and from the box it is fed to the grainers as required. The latter are long, shallow tanks, near the bottom of which, and extending throughout their full length, is a series of steam pipes. The brine being admitted to the grainers, the steam is turned on, the liquor soon acquires a high temperature, and rapid evaporation takes place. To assist the precipitation of the grains of salt, the surface of the brine is agitated at frequent intervals by means of a series of paddles which are operated by a lever at the end of the grainer. The salt accumulates at the bottom, until in the course of twenty-four hours there will be a layer from 6 to 8 inches deep. The salt is lifted from the grainer by means of long-handled, perforated shovels, and is deposited on the runway. As soon as it is thoroughly drained, it is shoveled into carts, run out over the storage bin, and dumped.



CONDENSER AND UPPER HALF OF VACUUM PAN.

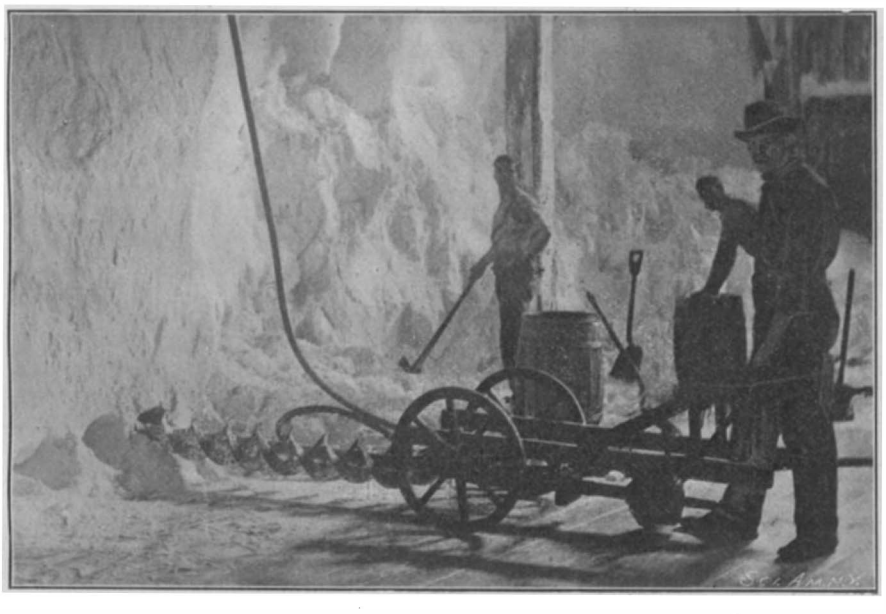


TOP VIEW OF A GRAINER, SHOWING THE BRINE, RUNWAY, AND AGITATING PADDLES.

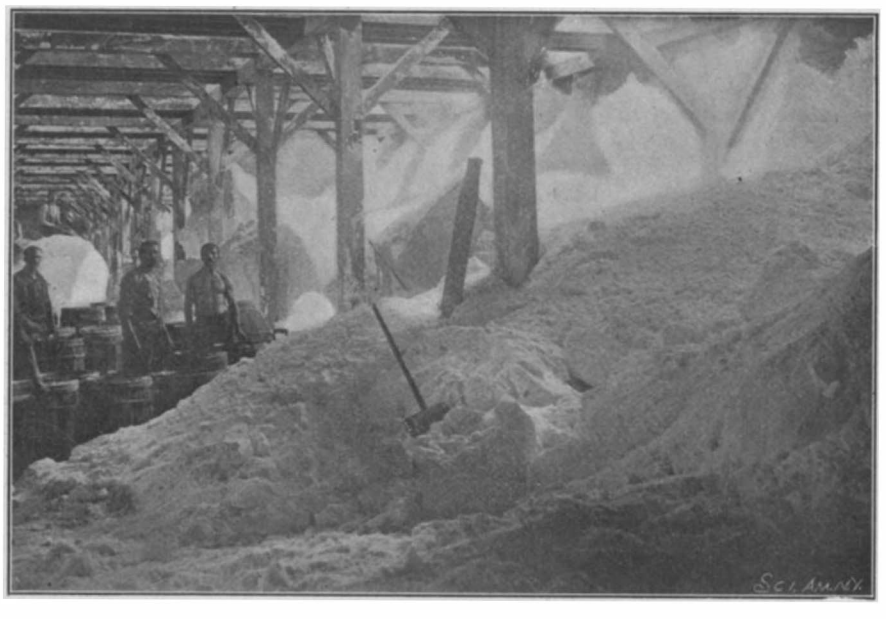
The plant under consideration consists of five wells, three cisterns each 18 feet wide by 100 feet long and 8 feet deep, and six settlers 12 feet wide, 175 feet long, and 8 feet deep, capable of holding about 24,000 barrels. When these cisterns and settlers are all full, they hold enough brine to manufacture over 10,000 barrels of salt.

Part of the salt manufactured in this plant is made by the vacuum-pan process, for which purpose two pans are in use. The general arrangement of this plant is shown in the accompanying line drawings. The pan itself has a diameter of 11 feet at the steam-belt, *B*, and stands about 50 feet in height. The steam belt consists of two copper heads connected by 1,100 copper tubes 2⅜ inches in diameter and about 4 feet 6 inches in length. There is also a large central tube which is about 3 feet in internal diameter. Below the steam belt the pan tapers to a pipe 12 inches in diameter that leads to the foot of an endless-belt elevator, which carries the salt up to the storage bin, *V*. Above the steam belt the pan enlarges to a diameter of about 15 feet and then contracts to form a 4-foot elbow, which enters the condensing chamber. The water for the condensing chamber enters at the top of the same, falls upon the spray-plate, *D*, and, after having absorbed the steam from the vacuum pan, passes down through the water pipe, the foot of which rests in a sealing tank, *H*. The evaporation is assisted by an air pump, *E*, the suction pipe from which enters the condensing chamber near the water inlet, and reaches to a point just below the spray plate.

In operating the plant the pans are first filled by gravity, after which the gravity supply pipe is closed, and the valve in the pipe connecting with the settlers, *R*, is opened, the brine being drawn into the pans by the vacuum therein as the evaporation proceeds. The water and the air pumps are inserted, steam is admitted to the steam belt, and the process of manufacturing salt begins. The atmospheric pressure being removed from the surface of the brine, the latter boils violently at a temperature which seldom rises above 150° F. The brine rushes upward through the tubes, and under the rapid evaporation the brine becomes so dense that it can no longer hold the salt in solution. Fine crystal grains are formed, as the liquid circulates through the large 3-foot opening in the steam belt, and falling to the bottom of the pan they pass to the foot of the elevator, whence they are taken up and dumped into the drainage bins. After the salt has remained in these bins for a period of sixteen to eighteen hours, it is drawn off into carts, wheeled to the storage bins and dumped. It is customary to use the pans for not longer than twelve consecutive hours, at the end of which period



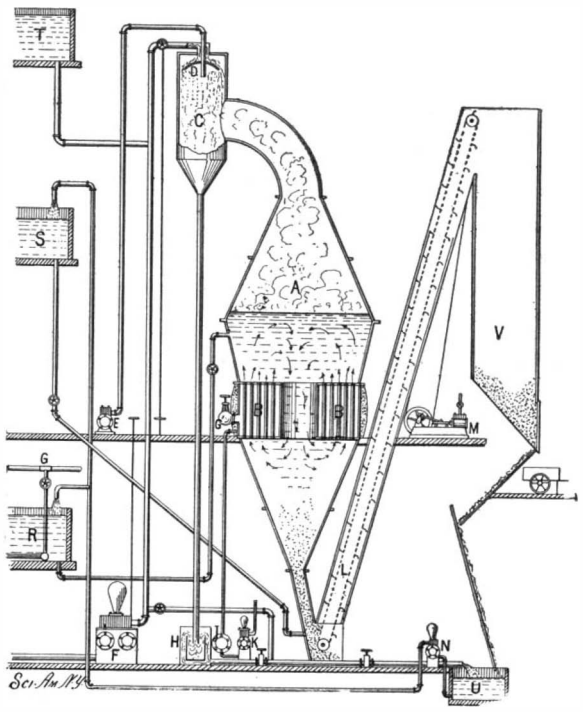
COMPRESSED AIR AUGER FOR LOOSENING COMPACT WALL OF SALT



SALT PACKERS AT WORK IN THE STORAGE ROOMS.

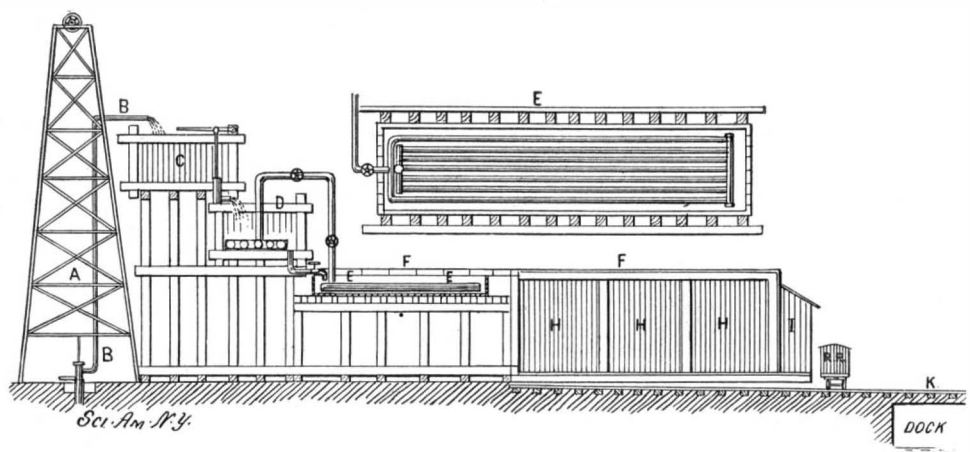
they are emptied, boiled out with fresh water, and cleaned. One of the pans is run during the day and the other during the night, each pan making in a twelve hour run from 600 to 700 barrels of salt, the combined production being from 1,200 to 1,400 barrels a day.

In the manufacture of salt it is a recognized necessity that a large quantity must be kept in storage, and for this purpose the salt is dumped into vast storerooms which measure from 200 to 300 feet in length, and the same in width; the amount in store frequently aggregated 400,000 barrels. As these rooms are from 16 to 20 feet deep the salt becomes tightly packed, and has to be worked loose by packers with picks, shovels, grubhoes, etc., who proceed to quarry, break up and pack the salt into barrels. With the coarser grades of salt made in the grainers this is not a difficult matter, but the finer grained, vacuum-pan salt becomes compact and very hard, and the packer soon finds himself confronted by a wall of salt 20 feet in height and as white, if not as hard, as marble. To undermine and bring down this mass of salt is a dangerous operation, and involves long delays; and to overcome these difficulties, the companies have used a compressed-air driven spiral auger, which is 10 inches in diameter and provided with a double spoon point. The auger is mounted on a truck and the back end of the shaft is attached to a 3 horse power Boyer rotary air drill machine. A row of holes is driven into the salt wall at a height of 10 inches from the floor for a distance of 6 feet into the mass, the holes being drilled as closely together as possible. After an interval of one to three hours, a fall of salt takes place, a mass equal to 400 or 500 barrels of salt being brought down in each section. The saving of labor by the use of the compressed-air drill is shown by the fact that sufficient salt can be undermined and caved in this manner in one-half day to keep the packers at work for two or three days following.




*A*, vacuum pan; *B*, steam belt; *C*, condenser; *D*, spray plate; *E*, air pump; *F*, cold water pump; *G*, steam pipe; *H*, sealing tank; *K*, hot water pump; *L*, elevator; *N*, brine pump; *R*, brine settler; *S*, brine tank; *T*, water tank; *U*, brine vat; *V*, drainage bin.

**VACUUM PAN PLANT.**




*A*, well derrick; *B*, brine pipe; *C*, cistern; *D*, settler; *E*, grainer; *F*, runway; *H*, store bins; *I*, packing shed; *K*, salt car tracks; *E*, grainer.

**A SALT BLOCK GRAINER.**

## MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS.

II. FLUID COMPRESSION AND FORGING.

Our first article of the present series on the manufacture of guns and armor was devoted to the Open Hearth process, which, it will be remembered, is used exclusively in the manufacture of steel at the Bethlehem Works. We have seen that steel which is to be worked up into armor plate is cast in huge ingots, the largest of which will weigh as much as 135 tons apiece; while the steel which is to be forged into guns (technically known as "gun steel") is subjected to what is known as the Whitworth fluid compression treatment, which is designed to secure in the ingot that density and freedom from internal cavities, flaws, and impurities which is indispensable to the production of the highest class of forgings. The same results are obtained in the armor plate ingot (though in a lesser degree) by casting them with a considerable excess of metal known as the "sinking head," which serves to compress the cooling ingot and collect the impurities at the surface.

Fluid compression, then, is designed to remove certain defects which are common to all steel ingots not so treated. Chief among these are "blow holes," "piping" and "segregation." When the metal is being poured into the mould, air is apt to be drawn in with it, producing cavities in the metal, a defect which is also liable to be caused at certain stages of the cooling of the ingot by the generation of gas within the body of the metal. The most efficient way of getting rid of this trouble is to subject the molten metal in the mould to heavy compression during the process of cooling. One of our illustrations shows the massive 7,000-ton press in which all the gun steel is treated immediately upon being drawn off from the furnace. The mould is built up of massive cylindrical segments to the desired height upon a movable platen, which is located at the bottom of the casting-pit. After being filled with fluid steel the mould is run under the hydraulic press and the steel is subjected to an increasing pressure. As a result, the formation of blow holes is completely prevented.

"Piping" is the formation of a hollow cavity through the center of the ingot. It is due to the fact that the metal solidifies first at the surface of the mould and, as it cools, shrinks away from the center and from the top, leaving a long, axial cavity through the ingot. In the big armor-plate castings, the extra metal in the sinking head is added to allow it to flow down and compensate for this shrinkage; while in the fluid compression process the hydraulic pressure forces the fluid metal of the upper part of the mould down through the center, thus securing the same result, but with a greatly improved density, due to the enormous pressure applied.

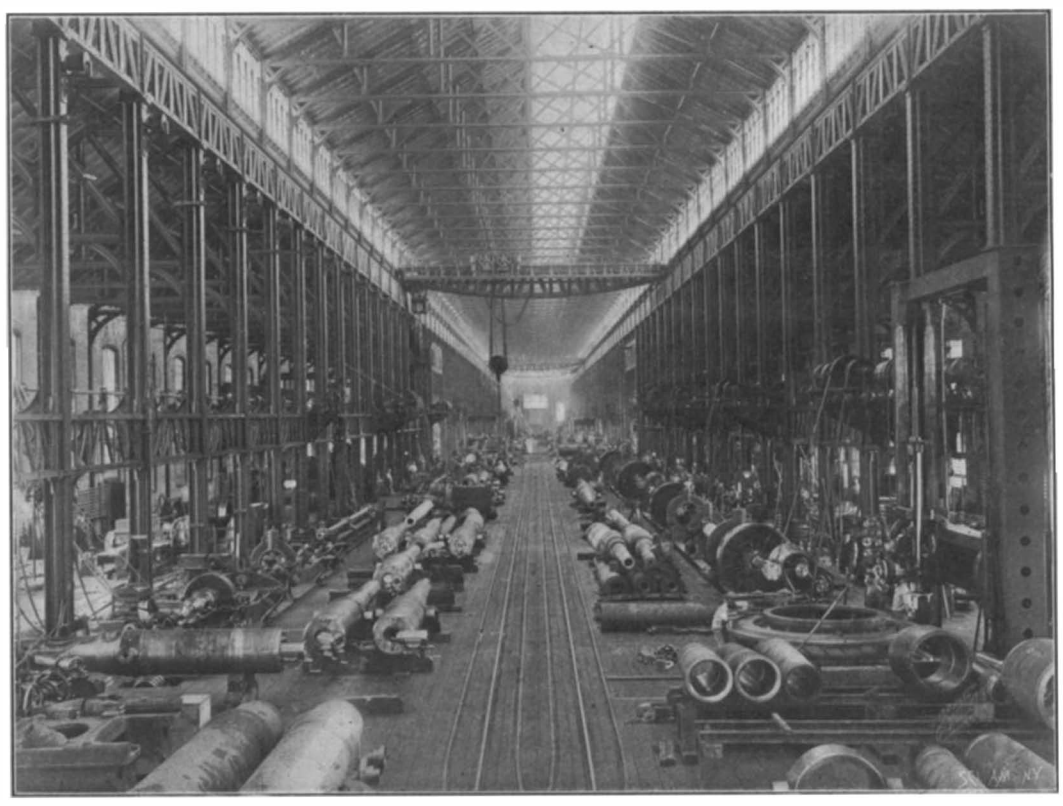
"Segregation" is a mechanical and chemical separation of the component parts of the solidifying steel due to the fact that each of them has its own temperature of cooling. Unfortunately, as the mass cools, each of the ingredients (sulphur, phosphorus, silicon, manganese, etc.) tends to flow toward the central and upper portions of the ingot, thus forming a central core of less purity than the body. Fluid compression greatly mitigates this tendency, and causes the segregation to take place toward the center and toward the upper extra length of ingot. Blow holes being absolutely prevented, the result is an ingot that is perfectly solid throughout its whole mass, while the segregation is removed by cutting away the head and boring out the central core before forging.

The fluid press, like much of the plant at this establishment, is of truly monumental proportions. It consists of an upper head weighing 120 tons, in which is carried the plunger, a 135-ton base containing the hydraulic cylinder, and four vertical connecting screws, each 50 feet long and 19 inches in diameter. The base is located entirely below the floor of the pit, and in our engraving only the head of the piston is visible. Above the piston is placed the platen upon which the mould is built up. The moulds vary in diameter and height, according to the size of the ingots. A plunger, to match the internal diameter of the mould, is attached to the head, and as the mould is raised the plunger bears down upon the fluid metal, preventing its escape.

As soon as the ingot has cooled it is taken from the mould and placed upon the lathe, and the extra length cut off and returned to the scrap heap. It is then placed in a boring mill and an axial hole bored through it. After this, it is reheated in a large gas-fired furnace, a process which must be carried out slowly, great care being taken to let the heat penetrate the metal uniformly; for sudden heating of the exterior while the interior was yet relatively cold would further increase the heavy strains which are set up in the ingot during the process of cooling. The ingot, it must be remembered, cools from the outside and shrinks away from the interior, and when it is cold the interior is in a condition of strain. If the reheating were done too rapidly, the surface metal would be pulled away still further from the center and the strains increased.

In the manufacture of gun steel, with which we are now dealing, the risks of overstrain during the heating are greatly reduced by what is known as hollow forging. Before reheating, as above stated, the ingot is put in the lathe and bored throughout its whole length, an operation which not only allows the heat to act more evenly on the mass of metal, but also serves to get rid of the impurities due to segregation, which, as we have already seen, gather in the center of the ingot. The boring out of the center permits the heat to act from the center outward as well as from the exterior inward, with the result that the metal expands evenly throughout its whole mass, and the danger of cracking is entirely removed. After the ingot has been raised to a temperature from 1,800 to 2,000 degrees, a steel mandrel is placed through its center, and it is picked up by a powerful overhead crane and taken to the hydraulic forging press. The mandrel serves in some sense as an internal anvil, and the work is concentrated upon half of the amount of metal that it would act upon if the piece were solid throughout. The consequence is that the metal receives more of that "working" which is the very essence of first-class forging.

There has been a radical change in the last few years in the methods of producing heavy forgings. The blow of the steam hammer has given place to the steady pressure of the hydraulic press. The pressure applied in forging a piece of steel should be of such a character as to penetrate to the heart of the metal, causing a flow of the metal to occur throughout its whole mass. Naturally the flowing of the metal requires that the proper amount of pressure shall be maintained for a sufficient period. The sharp, heavy blows of the hammer, it has been found, do not penetrate the mass of forging, nor do they produce the desired flow. In the earlier forgings, particularly those that were made for the shafts of steamships, the interior was found to have been but little affected by the forging and to be practically in the condition which it held in the ingot state. On the other hand, the slow-



Length, 1,375 feet; width, 116½ feet.

**BETHLEHEM STEEL WORKS—THE GUN-FINISHING MACHINE SHOP.**

protracted pressure of the hydraulic press gives ample time for the molecules of metal to flow over and around one another, and the effects are felt throughout the whole mass of forging. The center metal being the hottest is squeezed out, and the finished forgings have on their ends the convex shape which will be noticed in some of the accompanying engravings, showing that the flow of the metal has been satisfactory.

There are three large hydraulic presses at the Bethlehem forge. One of 2,000 tons, shown in our illustration, another of 5,000 tons, and a third of 14,000 tons. The first two are usually employed upon the gun forgings, while the biggest press, a truly monumental affair, is kept busy upon the huge masses of armor plate. The hydraulic press is constructed upon the same general lines as the fluid compressor. The hydraulic cylinder is carried in the upper head, and the travel of the piston is controlled by a hydraulic lever in the hands of an attendant. The disk and pointer carried at the side of the press indicate the number of inches of stroke of the piston, and as the same length of stroke is maintained throughout a complete revolution of the forging in the press, the piece is roughed out with an accuracy as to diameter and line that is remarkable, and greatly reduces the subsequent labor in the machine shop.

As it is impossible to complete the process of forging such large masses of metal in one heat, and the result of reheating, cooling and working at so many different temperatures is that the forging, as completed, is full of forging strains; to relieve these it has to be subjected to a final heat treatment which is known as "annealing." In annealing the forging is very carefully and slowly heated to a temperature which is slightly above the recalescent point (the point at which all crystallization is destroyed, and the molecules are thrown into an amorphous condition), and it is then allowed to cool very slowly. As it cools, the molecules rearrange themselves, according to natural law, leaving the metal in a state of complete rest. After the annealing, the gun-steel forgings, which consist chiefly of tubes and cylindrical jackets, are oil-tempered to give the necessary toughness to the steel. The forging is lowered into a large cylindrical furnace, where it is heated to a predetermined temperature, and it is then lifted out and lowered suddenly into a large cylindrical bath of cold oil, adjoining the furnace. This temperature being slightly above the recalescent point, there is not time during the cooling process for the formation of crystals, and the amorphous condition which the metal holds at that temperature is retained. The steel cools gradually, owing to the fact that oil is a poor conductor of heat, and the effect of the readjustment of the molecules is that the elastic limit and the ultimate tensile strength of the steel are greatly increased. The forgings are again annealed, in order to relieve the metal of any hardening effect due to the cooling process, and they are now ready to be taken to the machine shop, where they will be bored, turned and assembled into the finished gun.

The government specifications call for an elastic limit of from 46,000 to 53,000 pounds to the square inch, and an ultimate tensile strength of 86,000 to 93,000 pounds to the square inch. Moreover, the steel must show an elongation or stretch at the time of rupture in the testing machine of 15 to 17 per cent in a length of three inches.

We present an interior view of the gun-finishing machine shop, which is 116½ feet in width and has an extreme length of 1,375 feet, or over a quarter of a mile. A graphic impression of what these dimensions are may be gathered when we mention that our illustration is taken from the center of the shop, and presents only one-half of its full length. Here the forging for the A-tube, which forms the major part of the gun, is bored, given its finish reaming and turned on the outside. Then the jacket, a large cylindrical forging which has been bored to the required diameter, is shrunk on over the A-tube, and above this a number of shorter tubes are shrunk, to reinforce the gun over the powder chamber where the heaviest stresses occur. When all the hoops are in place, the gun is put in the lathe and turned to its final dimensions. It is then placed in a rifling machine, and shallow spiral rifling grooves are cut through the bore from the powder chamber to the muzzle. Then follow the construction and fitting of the breech mechanism; after which the gun is taken to the proving grounds of the company and put to the final tests.

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A NEW insulator for cables has been obtained by Mr. Heyl-Dia, of Germany, which has cellulose as a base. To the ordinary paper paste is added a non-hygrometric substance, such as oil, pitch or a solution of resin. The mixture is well stirred to render it homogenous, and from this paper is made by the usual process. The quantity of oil or resin varies, according to the nature of the paper paste, from 5 to 40 per cent. Another method is to add to the paste solid insulating substances, such as chalk, talc, etc. The quantity to be added to the paper varies in this case from 10 to 50 per cent.

## Science Notes.

The Proceedings of the Accademia dei Lincei contain a memoir of P. Tacchini, upon the earthquake which ravaged the Roman Campagna, on July 19, 1899. It commenced near the Alban Mountains, its epicenter being at Frascati in that city and in the environs the houses and public edifices suffered greatly. The shock was felt at 130 kilometers from the epicenter and was registered by the seismograph at the Observatory of Catania, which is 520 kilometers distant, its rate of propagation was about 4 kilometers per second. A series of interesting curves has been traced by the seismograph placed in the vaults of the Roman College.

Astronomy has recently lost two scientists who have contributed largely to its progress, R. Luther and G. Rünker. The former occupied the post of Director of the Observatory of Düsseldorf, and has discovered 24 asteroids; he died at the age of 78 years. Mr. Rünker was director of the Hamburg Observatory, and published an excellent catalogue of 12,000 stars; he devoted considerable time to the subject of chronometers and introduced a number of improvements in these instruments. The Observatory contains a large number of marine chronometers on account of the importance of the port of that city. Mr. Rünker was 68 years of age. Meteorology has also been deprived of one of its prominent workers, Mr. G. Symons, who was a member of the Royal Society, and president of the Meteorological Society of Great Britain.

The second International Congress of Hypnotism is to be held at Paris from the 12th to the 16th of August. The organization committee in convoking the congress recall the fact that the first congress, held in 1889, united a considerable number of physicians, professors of philosophy, magistrates, advocates and sociologists, and that the communications gave rise to a series of interesting discussions. The second congress has for its aim, first, to fix in a definite manner the terminology of the science of hypnotism, and second, to record and examine the acquisitions made up to the present time in the domain of this science. In order to give to the congress an exclusively scientific character, the committee will only accept communications relating to the clinical, medio-legal, psycho-physiological, pedagogic, and sociologic application of hypnotism and the phenomena relating to it. The congress will be held in the Palais de Congres of the Paris Exposition, the membership fee is 20 francs. All communications relating to the congress, such as requests for admission, manuscript or printed works, etc., should be addressed to M. Bérillon, 14 rue Taitbout, Paris.

A series of observations on the absorption spectra of gases has recently been made by P. Baccei, an Italian savant. As the gases have but feeble absorbent power, the action should be observed when they are submitted to great pressure. The experimenter has made a study of carbon dioxide, nitrogen, carbon monoxide, acetylene, oxygen and hydrogen sulphide. The first three gases do not present any appreciable absorption for a thickness of 70 millimeters under pressures varying from 22 to 10 atmospheres. For acetylene, oxygen and hydrogen sulphide, the absorption spectra become more complex as the temperature is higher. The spectrum given by a thickness of 25 millimeters of acetylene under a pressure of 16 atmospheres shows the following bands: a large band in the red between $\lambda = 0{\cdot}6842\ \mu$ and $\lambda = 6815\ \mu$, which is more intense on the side of the orange, being diffused next the red; a narrow and very distinct band is shown in the orange, at 0 6421 $\mu$; a second narrow band near the former (0·6417 $\mu$); a thick and well-marked band in the orange (0·6395 $\mu$); a band in the yellow (0·5707 $\mu$) and one in the green (0·5419 $\mu$) with a scarcely visible band beside it at 0·5435 $\mu$. When the pressure is diminished the absorption bands disappear successively, and at 10 atmospheres the band in the yellow is no longer seen; at 9 atmospheres those of the orange and green disappear. The spectrum of a thickness of 70 millimeters of acetylene at 16 atmospheres shows that the three rays in the orange form part of an obscure band, going from 0·6426 $\mu$ to 0·6395 $\mu$, and there is a very faint band in the violet at 0·4062 $\mu$, which disappears when the pressure is lowered to 14 atmospheres. The spectrum of oxygen shows a faint band in the blue, one in the yellow at D, and two groups of bands in A and B, which disappear successively in the order named when the pressure is diminished. The spectrum of 70 millimeters of hydrogen sulphide at a pressure of 12 atmospheres shows in the red a band extending from 0·6735 $\mu$ to 0·6781 $\mu$, which disappears at 7 atmospheres. As it has been generally admitted that a gaseous mixture gives an absorption equal to the sum of the absorbent effects of its components, M. Baccei wished to verify this supposition, and thus finds that for a mixture of acetylene and hydrogen in the proportion of 1 to 3, to obtain a given absorption band in the spectrum of the mixture, a quantity of the absorbent gas must be taken which would have given the same effect when used alone; other gaseous mixtures give similar results. His experiments show besides that the absorption spectrum of dry air is the same as that of oxygen under one-fifth the pressure.

## Electrical Notes.

The erection of a lofty mast on the Nantucket South Shoal lightship, is advocated. This is about 240 miles from Fire Island. This will enable vessels to communicate with New York fifteen or sixteen hours before they reach their piers, by telegraph.

Dr. Friedlander, of Wiesbaden, says Electricity, recommends galvanism to relieve the pain and irritation and to reduce the swellings caused by the bites of insects. The negative electrode is placed over the seat of the sting.

In a newly invented Jacquard loom 600 hooks are controlled electrically. The twill as well as the pattern is under complete control. The pattern of this cloth is woven directly from a photograph or print of the artist's design mounted on a metallic sheet; the threads of the web being picked up by electro-magnetic action owing to the figure of the pattern being cut away and thus allowing circuits to be completed by the metallic sheet.

By the aid of an English apparatus blue-printing can be done by electric light. It consists of a large cylinder of glass around which the tracings and the blue print paper are wrapped. They are held on the outside by a sheet of canvas. An enclosed arc light is lowered into the cylinder at any desired rate of speed, with the help of an escapement wheel and pendulum. A glass cylinder 9 feet 3 inches high and 2 feet 9 inches in diameter is in use at the Elswick shipyards.

A prize of $300 and a gold medal is offered to the designer of the best system of high speed and heavy traffic electric railways. The prize will be awarded by a committee of the German Society of Mechanical Engineers. The conditions call for plans of a railway connecting two distant cities upon which trains, having a minimum seating capacity for 150 passengers each, may be operated at frequent intervals at a speed of not less than 124¼ miles per hour. The contest closes October 6, 1900. It will be extraordinary if any meritorious plans are submitted for a prize of $300. It is doubtful if such great speed is desirable.

A new form of resistance for electric heating devices has been devised by M. Parville. It consists of a mixture of 60 parts nickel in powder and 40 parts of white clay. The mixture, which contains not more than 6 per cent of water, is brought to the desired form by compression, using a pressure of 2,000 pounds per square inch. The parts which form the contact points are made by a mixture of 90 per cent of nickel powder and 10 per cent of clay, in order to diminish the resistance at these points. As it is necessary that a resistance of this kind should not melt under the action of heat or otherwise deteriorate, the solidity possessed by the new compound is greatly in its favor.

Electric smelting on a large scale is to be tried in Switzerland near Meiringen, in the Bernese Oberland, and a concession has been obtained from the State for the working of an outcrop of hematite, says The Engineer. The vein has a thickness of 7 feet and is visible for a length of two miles along the mountain face. The ore will be transported by an aerial ropeway to Innerkirchen below. The concession obtained for the water power amounts to 60,000 horse-power. This will, of course, be more than sufficient to drive the machinery required and to supply the power for the electrical furnace. One of the difficulties which have beset the metallurgical industry in Switzerland hitherto has been the lack of fuel for smelting.

A system of telegraphy by which signals are transmitted by means of rays emitted from an arc lamp has been invented by Carl Zickler of Brunn, Austria. Rays of short wave length (mostly ultra-violet rays) are made use of, says The Western Electrician. These rays are sent out from the sending station at intervals corresponding to those of telegraphic signals, and in the direction of the receiving station, where they produce weak electric waves, by which the signals are made visible as sparks, or are made audible by telephone or electric bell, or, if preferred, may be printed by Morse apparatus. The most serious objection to the apparatus, however, is said to be the lack of speed, for so far it has been impracticable to arrange transmitters and receivers to accomplish more than eight to 12 words a minute.

Zinc plates are now covered with a layer of material in imitation of lithographic stone and the invention forms the subject of an English patent. The zinc plates are cleaned and laid in a solution of potassium bicarbonate, either with or without the application of an electric current. The zinc carbonate is thus deposited upon the surfaces of the plates forming a layer to which the imitation stone material to be subsequently applied firmly adheres. This stone material is composed of sulphate of lime, calcium chloride and aluminium oxide, and is produced by the action of hydrochloric and sulphuric acids upon limestone and aluminium, the yellowish shade natural for lithographic stone being obtained by the addition of a little ferric chloride. The mass is mixed with a solution of soda and is sprayed on the plates with the aid of an injector.

## OBSERVATIONS ON THE ECLIPSE OF MAY 28, 1900.*

BY HENRY RANDALL WEBB.

The Naval Observatory fitted out three expeditions under the general supervision and control of Prof. S. J. Brown, the astronomical director of the Observatory, which were stationed at Pinehurst, N. C., Griffin and Barnesville, Ga. While each of these expeditions was under the immediate charge of a staff of observers from the Naval Observatory, there were present at each several specialists from the scientific institutions of the country.

At Pinehurst, the eastern station, Prof. A. N. Skinner was in charge, assisted by Prof. Eichelberger, Mr. Theodore I. King, Mr. Culton and others from the Naval Observatory. Prof. Ames with his assistants was in charge of the spectroscopic observations. Prof. R. W. Wood, of the University of Wisconsin, was at Pinehurst with a stroboscope for observing the shadow bands, while Dr. F. L. Chase, of Yale University, made observations with an objective prism spectroscope. Drawings of the corona was the principal work at Pinehurst, both by the naked eye and by the telescope, the latter for sketching the finer details of the inner corona. For photographic work, instruments of various sizes were used, including the 40-foot photo-heliograph lens, giving an image of the sun 4½ inches in diameter. Each of these different instruments has its distinct advantage and it is necessary to use them all in an eclipse, in order to get the best results. The diameter of the picture is in proportion to the focal length of the instrument, but the difference upon the details is great. In the pictures made by the smaller instruments, the details of the corona near the sun are lost, but the general effect, including the length of the corona and the polar rifts, is distinctly marked. The larger lens with a greater focal length develops more distinctly the minor and very interesting details of the corona, while it fails to bring out the general effect.

The principal instruments in use at Pinehurst Station were two Dallmeyer lenses, 6 inches in diameter and 38 inches in focal length, and a Voigtlaender lens with 4 inches aperture and 8 inches focal length, besides the 40-foot photo-heliograph. The scaffold supporting it is double, the two parts being entirely separate; the outside part supports the tube of the large camera, while the inside part supports the lens. The plate holder is supported independently inside of the dark room. On the right of the picture is a shed, with canvas roof down, which protects the three equatorial telescopes and a polar axis supporting a number of cameras. Prof. and Mrs. Skinner are seen standing in front of this shed.

The three telescopes and the polar axis supporting the cameras appear in the second engraving. The barrel just above the shed is twelve feet from the ground and filled with water, which furnished the hydraulic head for running two water clocks or clepsydras; one to rotate the polar axis and one for moving the plate holder for the 40-foot photo-heliograph in the dark room.

In another engraving will be seen a nearer view of the portable transit house. This house has been all over the world with different eclipse expeditions.

Prof. W. J. Humphreys, of the University of Virginia, was in charge at Griffin, Ga.

This station had three different cameras. The largest was about 26 feet long and 12 feet wide, inside of which were reflectors upon which the result of the picture depended. The photographs were obtained by placing a highly polished silver mirror in front, where the sun would fall directly on its face. The reflection would be thrown from it into the camera through a slit, three-quarters of an inch in length and one hundredth of an inch wide; falling upon a plate of delicate speculum metal, it will be again reflected to a highly sensitive plate, where the negatives are secured.

The Barnesville station was under the immediate charge of Prof. Milton Updegraff, of the Naval Observatory. Prof. Brown chose this point to observe the eclipse.

Portable Transit House which has been used on Many Eclipse Expeditions.

But perhaps the largest collection of scientists was at Wadesboro, N. C., where were the observers from the Smithsonian Institution, Princeton University, the Yerkes Observatory and the British Astronomical Association. The party from the Smithsonian Institution was in charge of Mr. C. G. Abbot, and was accompanied by Dr. S. P. Langley, the secretary of the Institution, and several others. They had an immense camera, 135 feet long. The Princeton observers were eleven in number, in charge of Dr. C. A. Young, and included Prof. Charles Brackett, Prof. Taylor Reed, Prof. William Libbey and others.

Prof. George E. Hale was in charge of the Yerkes Observatory party. His special study was the heat of the corona by means of a bolometer, an instrument capable of responding to the slightest degree of heat. Prof. E. E. Barnard, of the same party, had charge of the apparatus photographing the corona. They had a camera 62 feet in length, provided with a sliding framework with seven partitions, by means of which seven pictures could be taken in rapid succession.

Four of the eight representatives of the British Astronomical Association were women in charge of Miss Gertrude Bacon, a distinguished amateur astronomer. There were many other important stations. The Weather Bureau had several within the belt of totality, noticeably one at Newberry, S. C., in charge of Prof. Cleveland Abbe and F. H. Bigelow, while the amateur observers numbered hundreds. Careful drills took place at the different stations, and every one had his duty assigned to him and his work to do.

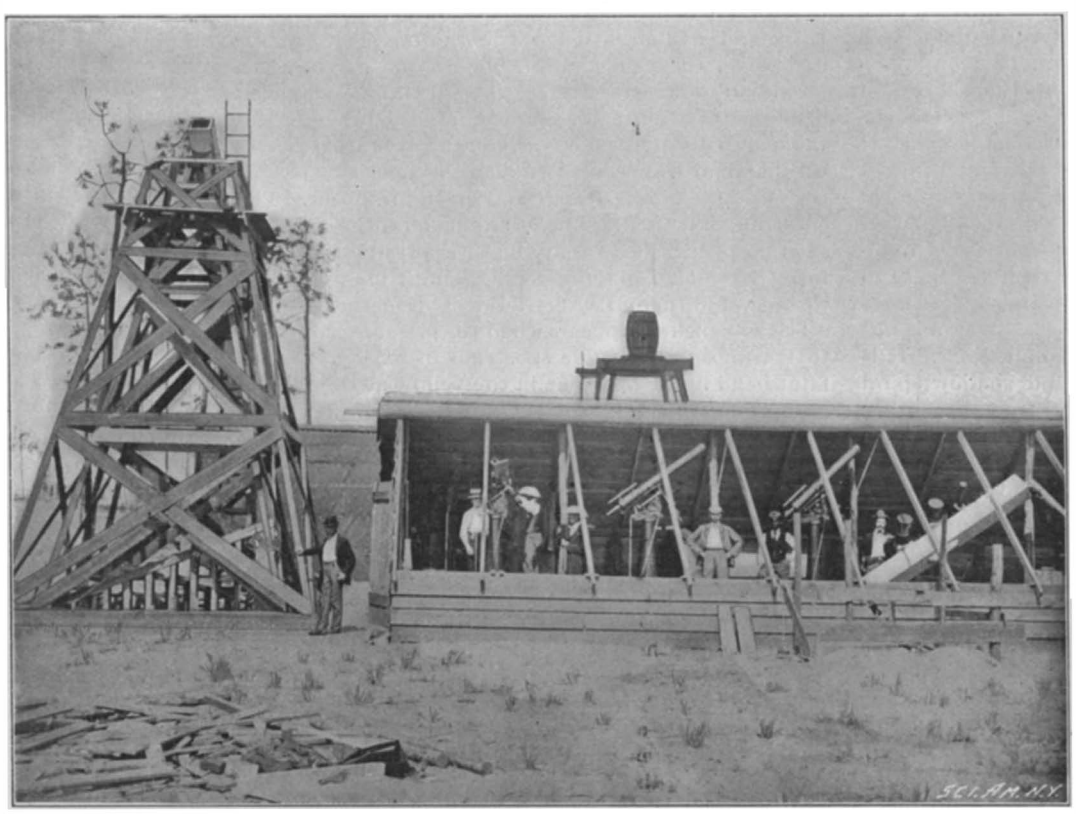
There was no disappointment in the weather during the eclipse, which left nothing to be desired at most of the stations. Many and valuable observations were made, but it will be some time before the numerous photographs which were taken can be developed and any definite results known.

Observations of the shadow bands varied very much at the different stations. Prof. Wood was not successful at Pinehurst, while two other observers at the same place were able to make a rough measurement of them showing that they were about five inches apart and moved at the rate of eight feet per second. At Barnesville, according to Prof. Brown, the shadow bands appeared like reflections of rippled water projected upon a screen. Prof. Quimby, who was at Wadesboro, said in regard to the shadow bands: "That curiously enough at every place where they were observed, they were different, that is to say, they moved in a different direction."

Dr. Langley said: "The bolometer was used for the first time in this eclipse, and by its aid the heat of the corona was successfully observed, and probably for the first time also."

Mr. Nevil Maskelyne also introduced a new feature by taking six hundred cinematograph photographs of the eclipse.

The 40-foot Photo-Heliograph on its Scaffold.



General View of the Eclipse Installation.

THE PINEHURST, N. C., ECLIPSE STATION OF THE U. S. NAVAL OBSERVATORY.

* It is not possible at the time of going to press to obtain satisfactory photographs of the eclipse. Most of the observing parties left their plates or their negatives behind in order that they might be carefully packed. The long exposure, while it develops certain necessary features of the eclipse, also results in the sun's rays burning out the negative in other spots and it has to be carefully worked up, a composite photograph being taken before anything satisfactory can be obtained. The results resemble the eclipse of 1878 very closely as figured in plate 21 of the United States Naval Observatory Report on the Total Eclipse of July 29, 1878.—Ed.

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A TRADE secret decision has recently been handed down in one of the German courts, which possesses considerable interest. The foreman of a factory invented a substance which was used by his employer in finishing rustling velvet. The Foreman imparted the composition of this substance to other makers, and was sued by his employer, and in the lower court was found guilty. The defense was that the foreman had only parted with his own invention which was his intellectual property. The case was appealed and was dismissed on the ground that the foreman was employed by the firm, and his invention was only a part of the service which he owed to his employer and only an employe would be trusted with experiments which would lead to such an invention. On account of the facilities which his position offered he was enabled to make an invention which an outsider would not have made, and that he made it in consequence of his employment, for which he was duly paid. The court held that when he imparted his secret to strangers he violated the German law for "the suppression of base competition."

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AN auroch's horn was recently found in a pit dug in lower Pomerania. It is believed that our domestic cattle are the descendants of aurochs. This animal survived on the Continent until 1627. Examples of its enormous horns may be seen quite frequently in churches and castles in Southern Germany, and in the south Rhine country.

## THE MUMMIFICATION OF CATS IN ANCIENT EGYPT.

BY W. S. HARWOOD.

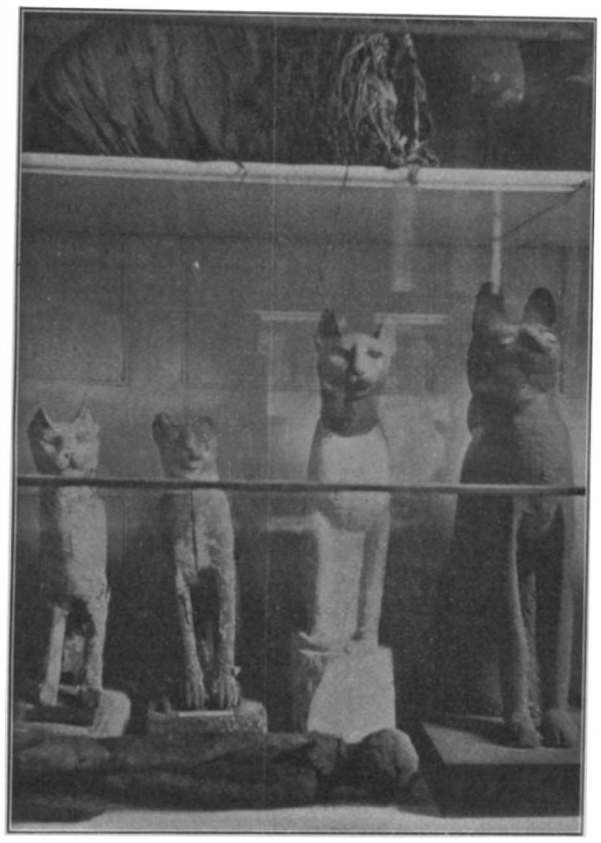
While the Egyptian children no doubt had as great regard for cats as the children of to-day, the parents had a still higher regard, rising into worship. So great was this regard that the cats came to be looked upon as sacred, and cat worship became a part of the religion of the race, while this worship found expression in great temples erected in honor of the cats who died. Shaving the eyebrows on the death of a cat in the family was a favorite means of showing the distress of the household.

So it was but natural to believe that in the future life the cats would live again with their young masters and mistresses, contributing to their happiness in the celestial land. On the death of the tabby, all due ceremony was observed, and with tender care she was embalmed and placed with the mummies of her family. You may see such mummies in the British Museum, wrapped in their cerements, fold upon fold enswathing the body with as great solicitude as though it were the body of the child who had owned the cat for its companion.

The cases in which the cats were placed after embalming were capital representations of the cat in life. Many of them were of carven wood, remarkably lifelike affairs, the form and even the individuality of expression being admirably preserved. Now and then some cat belonging to some more aristocratic family, when it departed for the heavenly cat land, received a case of bronze, beautifully ornamented and in all ways more in keeping with the standing of the family. Some of the cat cases are curiously decorated, and some of the faces are fitted out with queerly made eyes, inlaid with obsidian, or rock crystal; others are done in colored paste, the effect frequently being decidedly grotesque. The object in giving eyes to the case was that the spirit cat might have an opportunity to look out. An opening down the center of the case divided it into halves, so that the cat, when embalmed and ready for her last long journey to the land of the blessed, could easily be inclosed.

I found it quite difficult, indeed, impossible, to get a good light upon the darkish corner where the mummied cats were kept, for a London fog was abroad, and London, even at its brightest, is not a photographic paradise; but with some care and patience the cats came out of their sleep of the centuries and consented to show themselves to the camera.

The utmost care was given to these friends of the little children, that their lives might be prolonged to a ripe old age. Their food was prepared so that they might not only receive the most gustatory pleasure possible, but so that they might be richly nourished. One favorite dish was bread soaked in milk and mixed with chopped fish; surely no more tempting viand could be placed before the most exacting feline. In many cases, cats were kept in and about the temples which were sacred to the many gods of Egypt, and greater care could not have been given to human beings than that which was accorded to the cats. In



MUMMIES OF CATS IN THE BRITISH MUSEUM.

the current SUPPLEMENT the Mummification of Children is described.

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A NEW method has been brought out for lighting incandescent gas-burners of the Welsbach type, by which the accidents, due to the use of alcohol or gasoline, are avoided. It has been introduced by the French company which controls the Auer system of burner, and consists essentially of a small metal box in which is placed a plate composed of platinum sponge or platinized asbestos; this has the property of becoming incandescent upon contact with the gas, and is thus utilized for lighting it. The box is fixed upon the end of a metal rod, after the same manner as the gasoline reservoir formerly used; in the case of burners placed upon high posts a long pole is used, containing at the end the usual arrangement for turning on the gas.

## UNITED STATES BATTLESHIP "GEORGIA" AND CLASS.

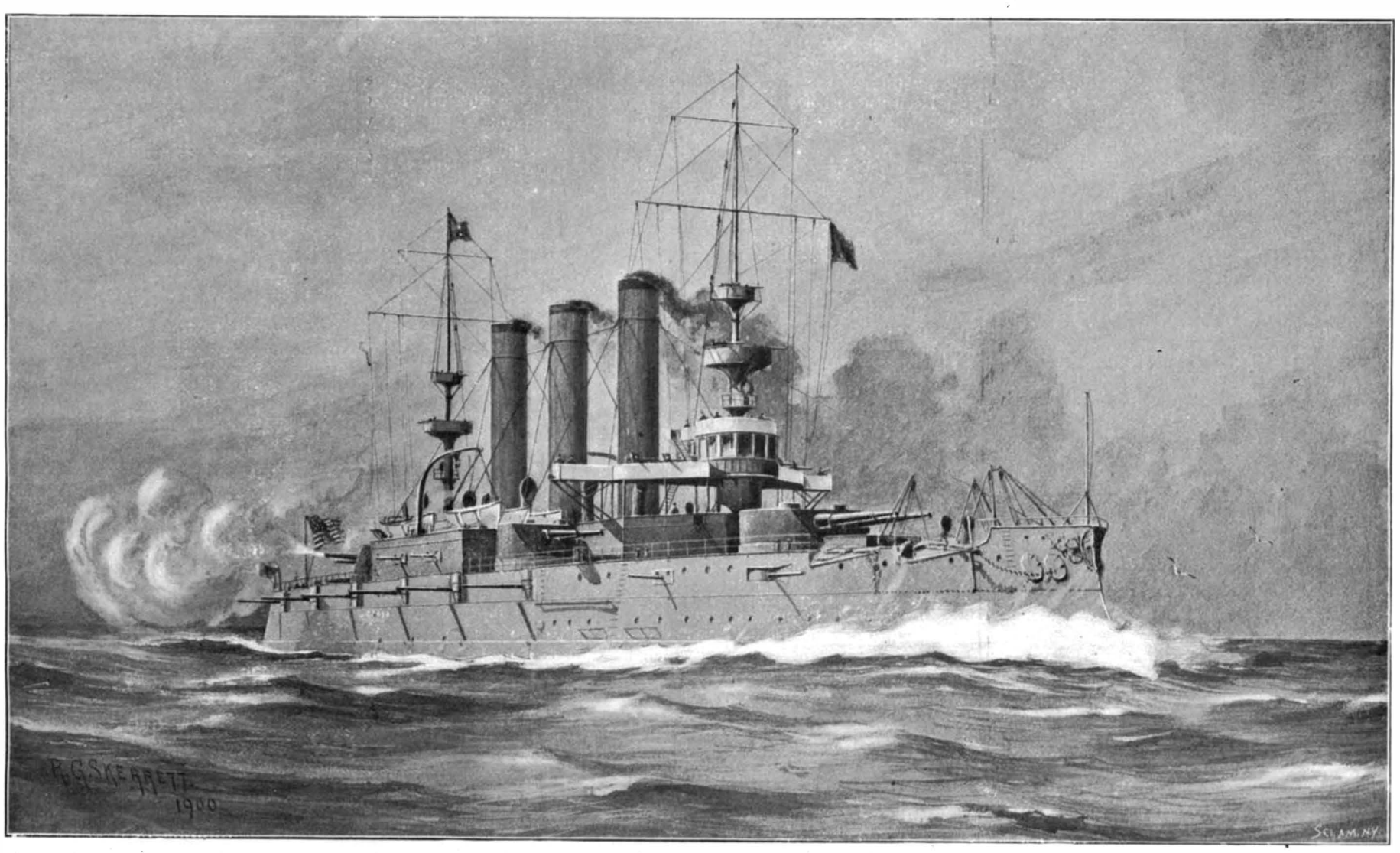
Whatever doubts the public may have had during the past fourteen months as to the character of battleships to be turned out under the act of March 3d a year ago, they are now dispelled by the circular recently issued to the various bidders by the Navy Department. From it we learn that the "Georgia" and her classmates, the "Pennsylvania" and "New Jersey," are to be ships of which any nation may well be proud and the fighting peers of any of their class built or building anywhere in the world. The general features and principal dimensions are:

| | |
|---|---|
| Length on load water line | 435 feet. |
| Beam, extreme, at load water line | 76 " |
| Trial displacement | 14,650 tons. |
| Mean draft at trial displacement | 24 feet. |
| Greatest draft, full load, about | 26 " |
| Coal carried on trial displacement | 900 tons. |
| Coal bunker capacity | 1,900 " |
| Maximum indicated horse power | 19,000 " |
| Speed, contract, per hour | 19 knots. |
| Complement, officers, seamen, and marines | 708 |

The ships will have the usual double-bottom and water-tight compartments. All fire mains will be carried below the protective deck, with risers leading therefrom up to the stations on the decks above. Woodwork will be fireproofed and will be limited to the indispensable minimum. The only planked deck will be the main deck, and the planking will be laid over a complete metal deck. The other decks in the living spaces will be covered with linoleum. The freeboard of the ships will be 20 feet, and will extend uniformly from bow to stern, yielding, especially, better accommodations for the officers—allowing their quarters to be placed without the armored region, thus permitting air-ports and natural ventilation in each state-room. The space in the superstructure will also be turned to advantage.

The armor protection to the hull will consist first of a complete water-line belt, which will have a maximum thickness of 11 inches amidships, and will taper to 4 inches at the bow and stern. Above this belt there will be a 3-foot cellulose belt reaching completely around the ships.

Above the main belt, for a distance of 245 feet, the space ocupied by the main, broadside and rapid-fire battery of six 6-inch guns, the sides will be guarded by 6 inches of armor, reaching all the way up to the main deck, on which are the turret guns. This upper and lower casemate armor turns inboard diagonally, and terminates against the forward and the after 12-inch barbettes, but the lower course, reaching from the protective up to the gun deck forward, is inclined—forming a stout glacis to oppose an enemy's raking bow fire. There is a continuous protective deck from bow to stern. On the flat, over the engines and boilers, it will be 1½ inches thick, and on the slopes, from



**Displacement,** 14,650 tons. **Speed,** 19 knots. **Maximum Coal Supply,** 1,900 tons. **Armor:** Belt (continuous), 11 inches to 4 inches; gun positions, 11 inches to 6½ inches; deck, 1½ to 3 inches. **Armament:** Four 12-inch B. L. R.; eight 8-inch B. L. R.; twelve 6-inch rapid-fire guns; twelve 3-inch rapid-fire guns; twelve 3-pounders; eighteen automatic and machine guns. **Torpedo Tubes,** two (submerged). **Complement,** 708.

UNITED STATES BATTLESHIP "GEORGIA" AND CLASS.

the barbettes forward and aft to the bow and the stern, respectively, it will be 3 inches thick and decidedly curved. The forward end terminates in the ram.

The main battery will be composed of four 40-caliber 12-inch breech-loading rifles and eight 45-caliber 8-inch rifles mounted in pairs in six turrets. The 12-inch turrets and barbettes will have a general thickness of 10 inches, with port plates of 11 inches. These turrets will be of the elliptical and balanced type. The 8-inch turrets and barbettes will be generally 6 inches thick, with port plates of 6½ inches. They will be circular and balanced. The face plates of all of the turrets will be flat and sharply inclined, so as to afford an elevation of twenty-odd degrees, greatly increasing the possible bombarding range of these pieces.

The secondary battery, or main rapid-fire battery, will consist of twelve 50 caliber 6-inch rifles, housed behind 6 inches of armor and carrying heavy shields. Each pair of guns will be separated by a 2½-inch nickel steel splinter bulkhead. These guns are arranged in recessed ports, which permit of the guns being turned in pairs, within the side line—one of each pair turning aft, while the other turns forward. These guns have arcs of fire of 110 degrees. The 12-inch guns train through arcs of 270 degrees, while the 8-inch guns train from dead ahead or dead astern back toward the beam through arcs of 145 degrees. The ammunition hoists will be under electrical control, as will also be the rammers, the elevating gear and the ventilating fans for the turrets.

Based upon the rate of ammunition supply, the 12-inch guns will each be able to fire every minute and a half, the 8-inch guns every fifty seconds, and the 6-inch guns three times a minute. Each of these pieces is vastly superior to the same guns of older caliber on any of the finished battleships, both in power and rapidity of fire. The auxiliary battery will be composed of the following high-powered pieces:

| | |
|---|---|
| 3-inch (14-pounder) rapid-fire guns | 12 |
| 3-pounders | 12 |
| 1-pounders (automatic) | 4 |
| 1-pounders (single-shot) | 4 |
| 3-inch field guns | 2 |
| Gatlings | 2 |
| ·03-caliber automatics | 6 |

Four of the 14-pounders will be mounted on each side of the gun deck, two forward and two aft of the 6-inch battery, while the four remaining, two on each side, will be mounted in broadside up in the superstructure on the main deck. All of the 14-pounders, besides their shields, will be sheltered behind broad plates of 2-inch armor. Two of the automatic 1-pounders will be placed in each of the lower military tops, and two of the single shot 1-pounders will be mounted in each of the upper tops. The other small rapid-fire guns, excepting the field pieces, will be mounted on the bridges and advantageously on the superstructure deck. There will be two submerged torpedo-tubes located well forward of the beam, and the firing stations, which will be directly overhead on the deck above, will be guarded against rapid-fire shot up to 6 pounds. The ships will each be driven by triple expansion engines actuating twin screws. These engines will be of the four-cylinder type and they are expected to make 120 turns a minute when developing the maximum 19,000 indicated horse power. Twenty-four straight-tube, water-tube boilers will supply the steam at a working pressure of 250 pounds to the square inch.

With her bunkers full, either of these ships, consuming about 75 tons of coal daily when jogging along at a ten-knot cruising speed, will be able to do at least 6,000 knots of uninterrupted steaming. They will carry three months' stores and provisions.

Thirty-six months is the maximum time which will be allowed in which to build the ships. There will be no speed premiums; but $50,000 a quarter knot will be deducted for speeds below 19 and not less than 18½. From 18½ to 18, $100,000 a quarter knot will be deducted, while below that, the department may either reject or purchase at its own figure.

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ACCORDING to the experiments of Valenta, it appears that red glycin is an excellent sensitizer for the blue-green rays. This product enters into the composition of a bath which is added to the ordinary gelatino-bromide emulsion for the preparation of panchromatic plates. The bath is prepared according to the following formula:

| | |
|---|---|
| Alcoholic solution of cyanine, 1 to 500 | 3 c. c. |
| Alcoholic solution of erythrosine, 1 to 500 | 2 c. c. |
| Alcoholic solution of saturated glycin | 10 c. c. |

The mixture is incorporated into the emulsion at the moment of applying it to the plates. The experiments seem to prove that by the use of these plates the rendition is exact for all the radiations which extend from the red to the violet of the visible spectrum.

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AS the Dneiper River takes a southwesterly direction in order to discharge itself into the Black Sea, it passes a succession of rapids, and it is proposed to utilize the power of the rapids for the generation of electricity.

### Paris Exposition Notes.

The United States pavilion at the Paris Exposition was opened to the public on May 12 with appropriate ceremonies and a formal reception in which the United States was congratulated upon the splendid showing made at the Exposition.

The total number of entries to the Exposition for the 10th of May has been 73,565, including the Vincennes Annex, of which at present the entries of workmen make up the principal part. The entries by ticket reached 35,471, those by card, 21,009 and the entries of service 14,085. At this date the admission has been established as follows: From 8 to 10 A. M., two tickets; from 10 to 6, one ticket; from 6 to 11, the closing hour, two tickets. The price of tickets is 12 cents.

The electric railroad and the elevated moving platform, which are among the attractions of the Exposition, are furnished with current by a handsome station erected within the grounds of the Westinghouse Company. This is located near the series of national buildings along the Seine. The station contains two sets of Westinghouse dynamos, one of these being used as a reserve. Each set includes a three-phase motor direct-connected to a direct current generator of 650 kilowatts, giving 500 volts, and a rotary current of 450 kilo watts, which transforms the current at 5,000 volts received from the central station at Moulineaux to 500 volts. A handsome marble switchboard of 13 panels occupies the central part of the station, and contains the devices for operating the road and platform. The station contains also six transformers of 120 kilowatts each and two small generating sets. A number of the machines intended for this station were on board the missing vessel "Pauillac," but other machines have been procured, and, owing to American enterprise, the station was running as early as the 10th of April. It has supplied most of the current for lighting the grounds, while waiting for the large dynamos in the Electrical Palace.

A new type of phonograph is shown at the Paris Exposition, this being the invention of a Danish engineer, Valdemar Poulsen. It works upon an entirely new principle, and the record, instead of being made in wax by a stylus, is made upon a steel wire by the action of a magnet. A cylinder is wound full of steel wire about one millimeter thick, the wires touching each other. In front, in a position analogous to that of the stylus, is a small electromagnet whose polar ends are brought out and are reduced to a small diameter to embrace the upper half of the steel wire. It is supported upon a horizontal rod, and the lateral motion obtained by a guide which travels between the wires. The magnet is connected with a telephone transmitter and battery, and the sound waves cause a variation in intensity of the electromagnet, and this in turn acts upon the steel wire passing before it, leaving a permanent impression. When the action is reversed, the wire reacts upon the magnet and the sound is heard in the telephone. The magnetic trace may be obliterated by passing a continuous current in the electro-magnet and turning the cylinder. The apparatus is to be seen in the Danish exhibit, and will be in working order within a short time; another form will be shown, in which the record is made upon a thin steel band wound upon a drum.

The University of Paris has an important exhibit in the Palace of Letters, Science and Art, containing a number of reproductions of photographs of the moon and of the heavens, covering a wall space of 18 meters long by 4 high. The large photographs of the moon are especially fine, and are presented to the public for the first time. They have been taken by Messrs. Loewy and Puiseaux with the large telescope of the observatory; the photographs are shown in small size in order to appreciate the fineness of detail obtained by the instrument, then a series of bromide enlargements is shown by which they are more clearly seen. One of the remarkable photographs is that obtained by taking two plates of the moon at ten and at twenty days after new moon; these have been enlarged sixty times the surface; and placed side by side with great care, the result being an image of the whole hemisphere of the moon with a direction of light which brings out the relief and shows the details of the craters and mountainous region in a striking manner. Messrs. Loewy and Piuseaux have developed their ideas upon the formation of the moon, as deduced from the photographs, in four memoirs which form a part of the exhibit, and to illustrate this are a number of photographs in which the details have been greatly enlarged. The Observatory of Paris, which has undertaken the map of the heavens in connection with other observers, has obtained for this a fine series of photographs with new equatorial of 18 meters focal distance, and has already published 117 sections of the map, containing 50,000 stars. Two of these sections are shown, enlarged to one square meter; each plate is exposed three times, being slightly moved, thus giving three images of each star to avoid errors. Another star-map shows a part of the ecliptic and belongs to a series taken at the observatories of Paris and of Algiers. Besides these is to be seen a photograph of the spectrum of Sirius taken by Prof. Henry.

### Automobile News.

An automobile service has been started between the Senegal and the Niger. The automobiles are run by Frenchmen and are of French make.

M. Krieger at present holds the record of electric automobiles, having covered a route of 152 kilometers at 16 kilometers per hour, without recharging the batteries. In all probability this record will be contested in the near future by Messrs. Bouquet and Garcin, who have lately made a trial trip with an automobile of their manufacture, from Paris to Evreux. It appears that they have covered the distance, forward and back, in 11 hours 15 minutes, which makes a speed of a little over 16 kilometers per hour. There is no doubt that an official contest will be made shortly over the route Paris-Dijon, which has been generally selected for this purpose.

There have been several serious accidents recently with automobiles in New York city. A doctor's page was killed by a head-on collision with an automobile. The boy was riding on a bicycle. One of the most prominent citizens of Binghamton was thrown from a runaway automobile, and sustained fatal injuries. The machine began running from side to side, refusing to respond to the controlling lever. When it reached a speed of 30 miles an hour it struck the curb, throwing the two occupants out. The machine continued its erratic course down the street, and was finally stopped by obstructions thrown in front of it by pedestrians. The wheels continued to churn the air for some time; the vehicle itself was not injured.

The motor car exhibition, which was held in London for a week from April 16th to the 21st, was a bitter disappointment to the hundreds who are now interested in the question of automobilism. Many of the stands were empty, but atonement was somewhat made for this deficiency by the comprehensive exhibits by several well known firms, such as the Daimler. At the close of the exhibition, a race was run upon a triangular course, through Great Britain, a total distance of 1,000 miles. This great trial was organized by the Automobile Club of Great Britain and Ireland and some eighty cars entered the contest. The object of the trial is to see how many types of British motors were in existence that were able to stand the test of such a long journey.

M. G. Pierron, president of the road committee of the Automobile Club of France, has recently published a year-book of routes which presents many points of interest. After giving information as to custom-house regulations to which the various types of automobiles and moto-cycles are submitted in the different countries of Europe, the year-book gives a number of formulæ and instructions of different kinds; then follow the rules for the circulation in the city and on the road. The year-book proper contains a list of all the towns and villages in the country, arranged in alphabetical order, with conventional signs to indicate the size and nature. The nearest railway station is indicated, also the existence of post-offices, telegraph and telephone services. Another series of signs show whether doctors or druggists are to be found in the locality, with indications as to hotels, etc. Mention is made of the places where gasoline may be procured, with indications of the different brands. The list gives also the distances from Paris and the number of inhabitants. This volume will no doubt prove of great service to automobilists.

The fourth annual Criterium race of moto-cycles has been one of the important automobile events of the season in France. It took place on the 10th of May, over the route from Etampes to Chartres and back, covering a distance of 100 kilometers. The weather was very favorable, and the race was carried out successfully; of the fifteen runners all but one came back to Etampes without difficulty. The results for this year show remarkable speeds, that of Marcellin, the winner, being 1 h. 24 m. 58⅘ sec., with a moto-cycle of two cylinders; the second speed was made by Baras, also with a two-cylinder machine: 1 h. 25 m. 8⅘ sec. Beconnais came third with 1 h. 27 m. 25⅘ sec., after having made the best time from Etamps to Chartres, or 50 kilometers in 37 m. 24 sec. The record made by Marcellin is inferior to that of Beconnais over the Arles-Salon route, 1 h. 22 m. 34⅘ sec., but far surpasses any yet made over the present route. The record of last year, made by Teste in 1 h. 56 m. 32⅘ sec., is not only beaten by 32 minutes by Marcellin, but also by eleven of the fourteen arrivals, showing the remarkable progress made by the moto-cycles. These three runners have carried off the honors of this year; Marcellin is victor in the Pau races, Beconnais in those of Nice, and Baras at Paris-Roubaix. In order to show the progress made in the last four years, the figures for the four Criterium races may be compared:

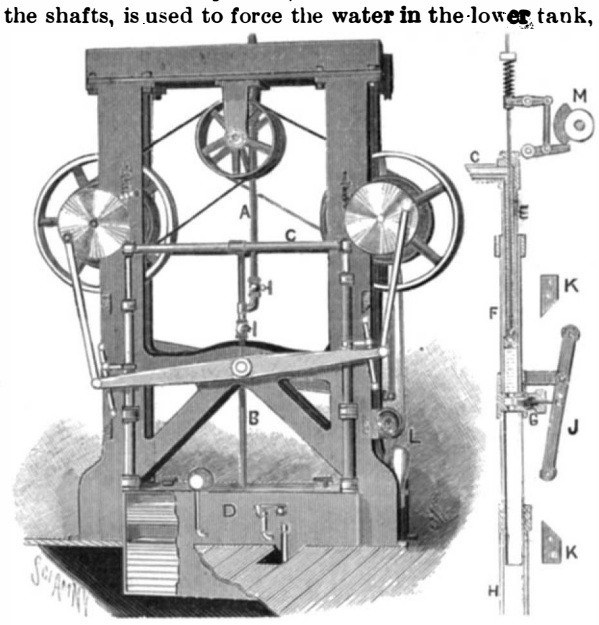
| | | |
|---|---|---|
| 1897 | Viet | 3 h. 9 m. 5⅘ sec. |
| 1898 | Bardin | 2 h. 21 m. 47⅘ sec. |
| 1899 | Teste | 1 h. 56 m. 32⅘ sec. |
| 1900 | Marcellin | 1 h. 24 m. 58⅘ sec. |

The figures show the remarkable increase in speed due to the constant improvement of the moto-cycles.

## AN HYDRAULIC MOTOR OF NOVEL CONSTRUCTION.

The illustrations presented herewith represent a general and a detail view of a new hydraulic motor, which has been patented by Bernhard C. F. Wall, of 147 Hampshire Street, Buffalo, N. Y. The motor consists of a frame, supporting two opposite pairs of actuating devices. Each pair of actuating devices is provided with hollow plungers, *F*, sliding at their upper ends on guide and supply pipes, *E*, and at their lower ends in cylinders, *H*. The two plungers of a pair are connected by a walking-beam, provided at its ends with pitmen extending to crank-disks secured on shafts, *M*. In each supply-pipe, *E*, a valve is arranged controlling an opening from the pipe to the plunger. The supply-pipes are connected by a pipe, *C*, communicating with a valved pipe, *B*, from which a valved supply-pipe, *A*, leads to an overhead-tank. The pipe, *B*, at its lower end, is connected with a tank, *D*, divided into two compartments, the lower of which is partly filled with water from the upper by means of an injector. The valve in each supply-pipe, *E*, is carried by a valve-stem, and is normally held to its seat by a spring, in order to disconnect the corresponding pipe from its plunger. The lower end of the spring presses on a lug secured on the valve-stem and operated by a projection on the shaft, *M*, of the corresponding crank-disk. When either shaft, *M*, is rotated, its projection will operate intermediate links and levers to push the valve-stem upward against the tension of its spring, and move the valve from its seat in the pipe, *E*. When this occurs, the water in the pipe, *E*, passes into the corresponding plunger, *F*, to press against the valve, *G*, held at this time in a closed position. The pressure of the water against the valve, *G*, forces the corresponding plunger, *F*, downward, the valve acting as an abutment; and the plunger, in moving downward, swings the walking beam, so that the opposite plunger moves up at the time the valve in the supply-pipe, *E*, is closed and the valve, *G*, is open. The oscillating motion of the beam is converted by the mechanism previously described into rotary motion to drive the shafts, *M*.

In order to open and close the valve, *G*, at the proper time, the stems of the valve are pivoted to levers, *J*. Friction-rollers are adapted to move alternately into engagement with inclines, *K*, in order to swing the levers, *J*, and to open and close the valves, *G*. The inclines are so arranged that each valve, *G*, is operated just before the corresponding plunger reaches the end of its stroke, whereby the valve, which has been closed on the upward movement of the plunger, will remain closed until the plunger has nearly reached the end of its downward movement. The water under pressure is constantly in action on one of the plungers to impart a uniform rotary motion to the shafts, *M*, connected by belt and pulley with a common driving shaft. An air-compressor, *L*, connected with one of the shafts, is used to force the water in the lower tank,




THE WALL HYDRAULIC MOTOR.

*D*, to the plunger supply-pipes when the overhead tank runs dry.

## AN ATTRACTIVE DWELLING AND CONSERVATORY FOR $8,500.

The dwelling house illustrated in this issue is located at Pelham Heights, N. Y., and it is claimed to have cost complete only $8,500. The last February issue of the Building Edition of the SCIENTIFIC AMERICAN not only contains the elevation view, shown herewith, but plan views of the interior and a full description of the kinds of woods used in the different rooms and the other materials used in the construction and finish. In brief, the cellar is cemented, and is used for the laundry and furnace. The house is fitted for both gas and electric lighting. The kitchen is provided with a double oven range and an 80 gallon boiler.

One special feature of the SCIENTIFIC AMERICAN Building Edition is that it contains photographic reproductions of inexpensive country homes which have been actually built. This monthly journal is most useful to architects, builders and others in calling attention to the latest work in the building line. The subscription is $2.50 per year.

## Correspondence.

### International Congress at Paris.

To the Editor of the SCIENTIFIC AMERICAN:

I have received a letter from the chairman of the committee in charge of an international congress, which will be held in Paris, in relation to the Exposition taking place there at present, and where all questions arising from recent inventions will be discussed, and, therefore, the associations of inventors, the associations of industrial artists, the inventors and the industrial artists individually and all those who are interested in the progress of inventions and of individual industrial arts, will be invited to assist at said congress.

I would, therefore, be much obliged to you if you would kindly let me know whether you have the names of any such associations, so that I may have invitations addressed to them by the French government.

HENRY E. GOURD.

Chambre de Commerce Française de New York.
May 26, 1900.

### The Current Supplement.

The current SUPPLEMENT, No. 1275, is of unusual interest. The first installment of an important paper entitled "Outline of the Development of the American Locomotive," by George L. Fowler, begins in this issue. The series will be accompanied by sixteen engravings made from drawings which are to be exhibited at Paris. "Rails and Rail Joints" is accompanied by twenty-two engravings. "Alcohol as a Food" is by A. T. Cuzner, M.D. "The Electricity Building and the Grand Cascade of the Paris Exposition" are illustrated and described. "Egyptian Mummies of Children" is by W. S. Harwood. "The Eclipse at Wadesboro, N. C.," is described in detail. "The Twelfth Census of the United States" is by George E. Boos, Superintendent of Printing, and a tabulating card, showing the data for the electric tabulating machine, is given.

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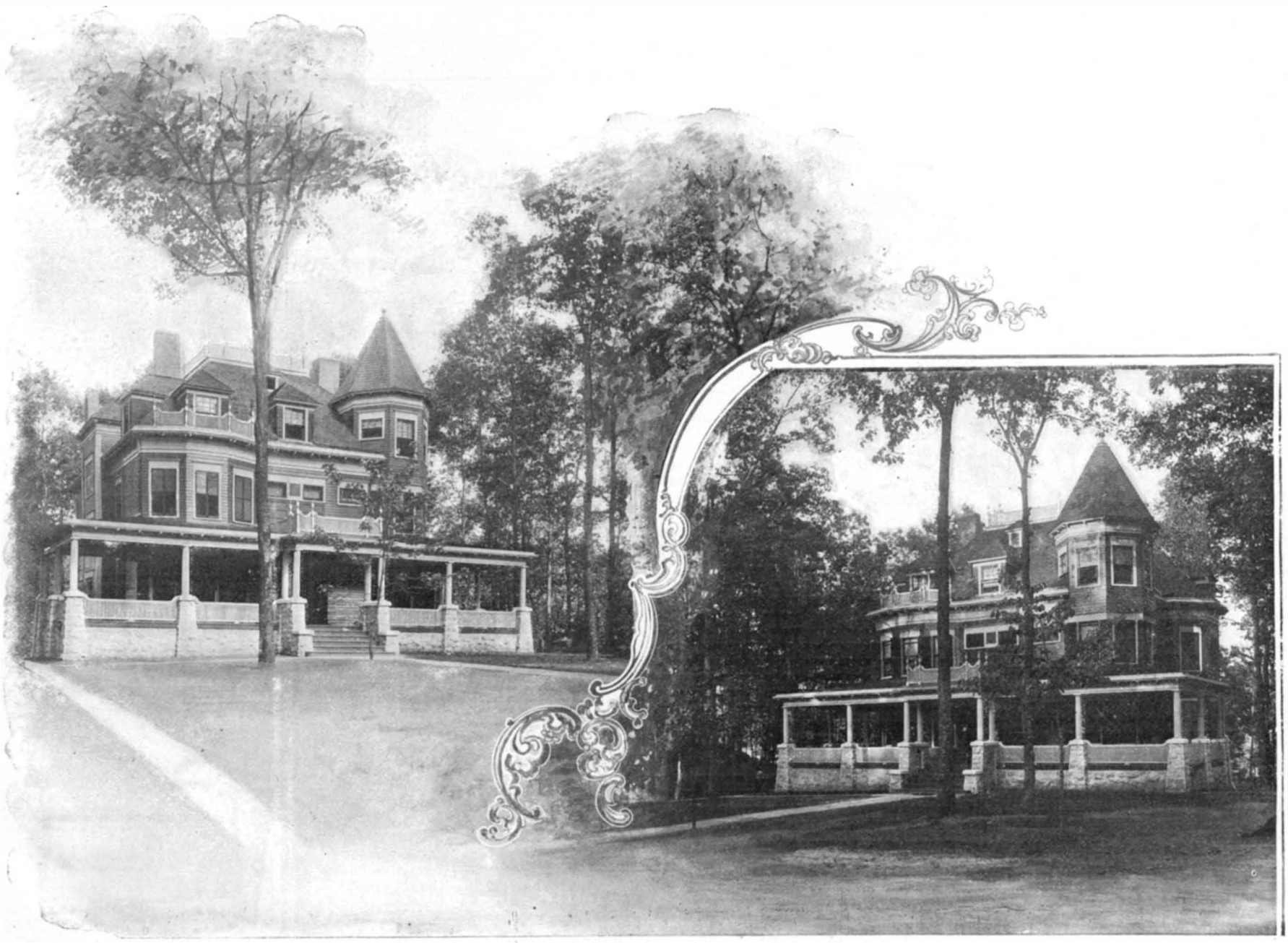

MR. DOMINICK SMITH'S DWELLING AT PELHAM HEIGHTS, N. Y.—MR. A. M. JENKS, ARCHITECT.

## RECENTLY PATENTED INVENTIONS.

### Agricultural Implements.

WHEEL-HARROW.—Millard F. Potter and Henry J. Minar, Austin, Minn. The invention is a harrow of that type in which the harrow frame is made in sections, the two side sections of which are hinged, so as to be turned up on each side into a vertical position to facilitate transportation and to avoid stumps, stones, or other obstructions. The several drags run freely and independently of one another. The driver can ride to and from the field. It is impossible to turn the drags over the horses. In turning, the drags are not liable to be thrown against the wheels, nor the horses against the drags. The drags can be tilted to change the inclination of the teeth and raised bodily or on their hinges to free them of rubbish.

PACKING ATTACHMENT FOR GANG-PLOWS.—David E. Towle, Park River, N. D. This packing attachment consists of a frame, in which a wheel is mounted to turn. The rim of the wheel is inclined, is provided with recesses in its side edges, and is solid between opposite recesses. This peculiar formation of the rim tends to roughen the surface, while the wheels act to pack the soil in order to preventing drifting. In loose and sticky soil the benefit of packing is marked, for the plow works and cleans more efficiently in subsequent operations.

### Engineering-Improvements.

ROTARY ENGINE.—William W. Watkins, Yuma, Arizona Territory. The engine comprises a rotary wheel having peripheral cups. Steam is admitted to the casing and discharged upon the wheel by means of a pipe having two branches extending around the wheel. The steam can thus be caused to impinge on the wheel at opposite points. Hence, by providing a rotary, two-way, cut-off valve in the main supply pipe, the steam can be deflected into either primary branch in order to cause the wheel to turn in either direction.

ROTARY ENGINE.—John J. Anthony, Moscow, Idaho. This engine is provided with a cylinder in which are a number of sliding abutments. On the cylinder-heads are chests. The rotary piston is provided with a number of piston-heads and is mounted to rotate in the cylinder, and is arranged to admit steam to the cylinder from both chests at the same time, into separate compartments of the cylinder. Separate exhaust-pipes lead from the cylinder. The abutments are controlled by cam-wheels having cam-grooves so arranged that the abutments are simultaneously moved outward or inward to allow the piston-heads to pass, the inward motion occurring immediately after the heads have passed the abutments.

AUTOMATIC CYLINDER-COCK.—Louis M. Morrow, Wasco, Ore. The invention provides a new cock designed for use on steam-engine cylinders and arranged automatically to open in order to discharge the water of condensation to prevent blowing out of the cylinder-head or bending of the piston-rod, at the time the engine is started, should the engineer fail to open the usual cylinder-cocks.

VALVE.—Timothy S. Martin, Butte, Mont. The object of the invention is to provide a simple mechanism for simultaneously operating a number of valves, closing one or more of them, while the others are opened and *vice versa*. The mechanism is applicable to valves controlling the admission of steam or water to radiators. When used on a steam-radiator, the device reduces the resistance to the boiler-pressure. For the steam, when cut off from the radiator, does not encounter a solid, closed valve, as in the ordinary construction, but passes through the valve-casing and back to the boiler, thereby obviating any resistance to the boiler-pressure.

### Mechanical Devices.

BOTTLE-WASHER.—Edmund S. Purdy and Jesse W. Washburn, Portage, Wis. This machine comprises a rotating tank having ports in its sides. Shot-carrying pockets are arranged in the tanks, which pockets have outward openings. Plates are movable on the outer side of the tank and have ports designed to be placed in communication with the perforated shot-pockets. Boxes are arranged at the ports through the controlling-plate, for receiving the mouth end of the bottles. Free passage is given to the water from the tank to the bottles. After rinsing, the shot-pockets are opened to allow a free communication of the shot with the full length of the bottles. The shot-pockets are then closed and the bottle finally rinsed. The revolution of the tank insures the washing of the outside of the bottle.

ELEVATOR.—Peter S. Ebbert, Manhattan, New York city. In large stores, goods sold in the several departments and intended to be delivered to the customers, are generally sent to the top floor to be distributed among the wagons. It is the usual practice to carry the goods to the wagons in baskets, a process which requires much time and labor. The present invention provides a simple elevator, by means of which goods deposited in it at any floor are automatically discharged at the distributing floor or room, thus saving time and manual labor.

GRUBBING-MACHINE.—George R. McChesney, Manhattan, New York city. The lever of the grubbing machine is provided with a strengthening-strap attached to its front end. A saddle-plate is saddled on the front end of the lever, and has its ends engaged with the strengthening-strap. The strengthening-strap serves primarily to receive the strain on the lever, which strain is communicated directly to the lever by the saddle-plate. The construction is designed to prevent the breaking of the lever, which often occurs with the usual grubbing-machine.

COMBINATION-LOCK.—Niels P. Nielsen and Junius L. Murphy, Denver, Colo. The object of the invention is to provide an improved lock designed for use on bicycles and other machines, and arranged to protect the owner of the article from theft, both by locking a movable part and by rendering the removal of the entire lock impossible, without leaving traces on the article. Stolen property, by this means, can be readily identified.

### Miscellaneous Inventions.

ANIMAL-YOKE.—George Lang, Billings, Oklahoma Territory. The yoke is provided with extensions which are designed to be entangled with or brought in contact with a fence whenever the animal attempts to cross the fence. Rocking-bars are employed bearing barbs which, when the "poke," as it is often called, strikes the fence, cause the shaft to rock and thrust the barbs into the neck of the animal to deter its further progress. Stock can be kept in an inclosure with only one wire; and barbed wire can be dispensed with altogether.

RAM.—George A. and Thomas F. Penrose, Meredith, Ark. The ram is intended to enable workmen conveniently to shift a rail longitudinally toward or from an adjacent rail. The ram comprises a clamp adapted to be fastened to one of the parts to be operated on. A lever is fulcrumed on the clamp; and a grip is mounted loosely on the other part but adapted to grip it firmly on being tilted. A link connects the lever to impart a tilting motion to the grip and bring the latter into a gripping position on its part. A plate, adjustably held on the grip, has a foot piece for holding the grip in a sliding position on its part.

BRUSH.—Julius C. Lüdke, Racine, Wis. The brush is made for the reception of soap and for the supply of a soap solution to the bristles. Hitherto the suds were allowed to run directly through the brush, so that the bristles were loosened. Mr. Lüdke has overcome the difficulty by providing lateral channels which prevent the suds from loosening the bristles.

AWNING.—Louis Wolf, Manhattan, New York city. The object of the invention is to provide an awning which can be easily manipulated, which is arranged to permit perfect ventilation, and which permits the head and main awning to be securely bound in closed position to render them storm-proof. The main awning is mounted on rods slidable in the window-frame. The head awning is provided with a base-frame, the side bars of which are pivoted on the slide-rods of the main awning.

WIRE-DRAWING MACHINE.—Moritz von Watzesch, Oberschoenweide, Prussia, Germany. The invention is a wire-drawing machine in which a vertical shaft driven from some source transmits its revolution to the wire-drum above, on which the wire drawn is to be wound. A friction-clutch is provided between the driving-gear and the vertical shaft so as to place the wire-drum entirely under the control of the operator. The friction-clutch is actuated by a lever mechanism regulated by a special mechanism.

ROTARY AMALGAMATOR.—Alfonso Z. Baldenebro, Mexico, Mexico. After escaping through the bottom of a channel, the material is spread upon a table, owing to the rotation of which, it runs down in spiral lines. During this travel it is subjected to the action of streams of water delivered from various nozzles, and also to the action of mercury. The amalgamated surface of the table will retain a very large proportion of the valuable material. The potassium cyanid will dissolve some of the gold, and the solution can be treated in any approved manner.

RUNNING-GEAR FOR VEHICLES.—Turner Byrd, St. Louis, Mo. The axles of this vehicle are so constructed that the ground-wheels can be firmly secured in place and that the axles, when connected with their beds, will have extended bearings and will turn with little friction. The front and rear axles are constructed in independent sections, having independent bearings and are adapted to axles of two, three, or four wheeled vehicles.

CONVERTIBLE HANDLE AND STRAP.—Alfred W. Furnivall, Astoria, Queens, New York city. The device comprises a strap designed to be folded upon itself and provided with clamping means at the ends of each fold, whereby the folds can be secured together. By this invention a strap can be adapted for use as a handle as well as for its ordinary use as a strap.

FORMER FOR GUTTER-HANGERS.—James E. Hynes, Hannibal, Mo. The object of the invention is to provide a former for wire hangers, whereby a piece of wire can be quickly formed into the desired shape to produce a strong and durable hanger very cheaply. Little skill is required to form a piece of wire into a strong and durable hanger conforming in its bottom portion to the cross-section of the gutter, so that the hanger fits snugly on the gutter and also forms a brace on the inside of the gutter to hold it firmly and stiffly in position, without the use of the soldered brace heretofore employed.

HAIR-CLAMP.—William J. Koenig, Manhattan, New York city. The purpose of the invention is to provide a clamp which can be applied to braided hair so as to prevent the loosening of the braid. This end is attained by a clamp formed in two sections and provided with a rubber lining, which serves not only to engage and hold the hair but also to form a spring tending to open the two sections of the clamp, and further to prevent injury to the hair of the wearer.

ACETYLENE-GAS LAMP.—William F. Goeltz, William M. Gilbert and John Frain, Waterbury, Conn. By moving the body-cup upward with relation to the water-fount, a water valve is moved off its seat. By allowing air to pass downward into the water-fount, water flows to the carbid. The flow of water can be instantly checked by shutting the air-opening. By providing the carbid-receiver with a removable cover carrying the governor, it is obvious that the receiver can be thrown away after the carbid has been consumed, and a new receiver put in place, thus obviating the necessity of cleaning the receiver. The lamp is characterized by the simplicity and ingenuity of its construction.

### Designs.

RADIATOR.—John F. Thomson, Manhattan, New York city. The design combines an auxiliary heating apparatus with a radiator of novel construction in order to obtain a greater heat-radiating capacity.

HANDLE FOR SPOONS, FORKS, AND SIMILAR ARTICLES.—Joseph Smith, Taunton, Mass. Six patents have been granted to this designer for handles to be used on forks, spoons, knives, and the like. The designs are all noteworthy for the artistic taste displayed.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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## Notes & Queries

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**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated: correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

**Buyers** wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

**Special Written Information** on matters of personal rather than general interest cannot be expected without remuneration.

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**Minerals** sent for examination should be distinctly marked or labeled.

(7898) H. G. D. writes: Having need of several small glass disks of a uniform diameter, I find the lathe much more expedient in cutting them than the method by hand. I cut the glass into squares a bit larger than the required diameter, and taking each in turn I place them against the face plate of the lathe, holding them in place by a piece of wood for a center and the usual tail stock for a bearing, with a common cheap wheel glass cutter clamped in the tool rest. I had no difficulty in getting a clean, even cut in every case. The swing of the lathe seems to be the only limit to this method and the time consumed is less than that required to make a pattern by the ordinary method.

(7899) J. W. E. asks: 1. What in your opinion causes stripping or peeling of nickel plating? A. The usual causes are too strong a current, too acid a bath, or insufficient cleaning and pickling. 2. Is there any loss or waste of nickel in the electric bath? A. There should not be any waste in the action of the current upon the bath. 3. Is there anything with which the wires can be coated upon which the articles are suspended, so they will not become coated with nickel? A. Gutta percha covered wires will prevent most of the trouble. Greasy wires will not take a coating.

## NEW BOOKS, ETC.

**AMES ON FORGERY. Its Detection and Illustration. With Numerous Causes Célèbres. By Daniel T. Ames. San Francisco and New York: Published by the author. 1900. 8vo. Pp. 293. Sheep. Price $2.**

This is the most entertaining law book we ever remembered to have seen. The author is a specialist, a well-known handwriting expert who has had over 1,200 cases come under his cognizance. So much now depends upon the slant of writing or a small break or change in the character that it behoves all lawyers to become acquainted with some of the phases of the subject; he can do this the best by a careful perusal of this book with its numerous cases.

**DIE MODERNE CHEMIE. Eine Schilderung der chemischen Grossindustrie. Von Dr. Wilhelm Bersch. Parts 26-30. Vienna: A. Hartleben. 1900. Price per part, 70 cents.**

With Part 30, Dr. Bersch's undertaking is ended. Reviewing the work as a whole, it cannot be denied that it embodies a clear, popular description of the most important chemical processes which are now used. The illustrations in the main are excellent; some of them have been taken from the Scientific American, notably those relating to the manufacture of Bessemer steel.

**VON LOEBELL'S JAHRESBERICHTE UBER DIE VERAENDERUNGEN UND FORTSCHRITTE IM MILITAERWESEN. XXVI. Jahrgang: 1899. Herausgegeben von v. Pelet-Narbonne, Generalleutnant z. d. Berlin: Ernst Siegfried Mittler und Sohn. 1900. Octavo. Pp. 573. Price, paper, $4.**

The Twenty-sixth volume of Von Loebell's "Jahresberichte" discusses the development of military science in the year 1899. The first part is devoted to a treatment of the changes made during the past year in the various armies of the world and includes a description of the South American forces, which, hitherto, found no place in the "Jahresberichte." The second part treats of military science, particularly of tactics, scouting and armament and likewise includes an excellent bibliography of military literature for 1898-1899. The last part is composed of critiques of the military events which occurred in 1898-1 99. Of particular interest to Americans is the discussion of the Cuban campaign of 1898. The criticisms made, although sharp, are nevertheless impartial; they are all the more valuable for their having been made by men who know whereof they speak. The Transvaal war is chronicled up to the retreat of Buller across the Tugela River, on February 8.

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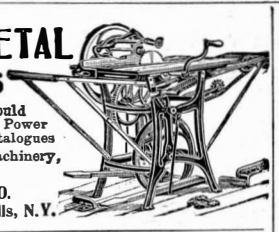

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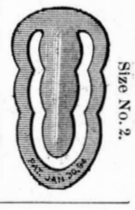


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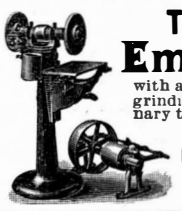

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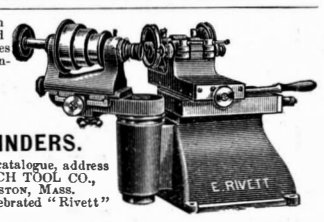


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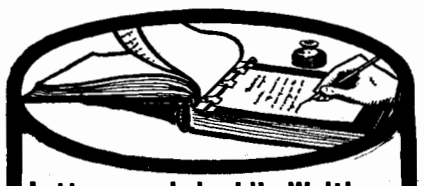

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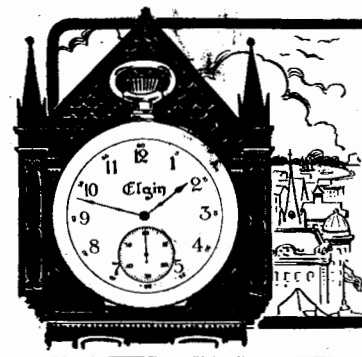

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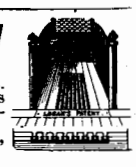

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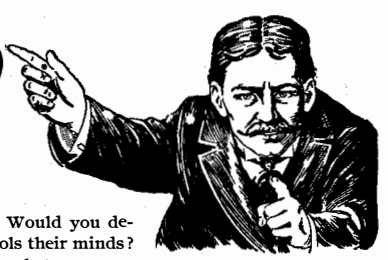

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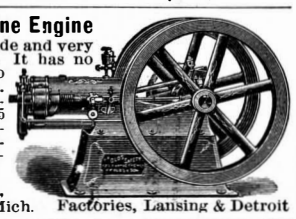

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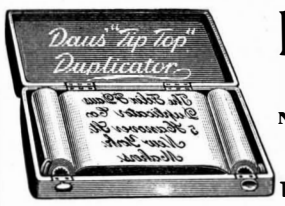


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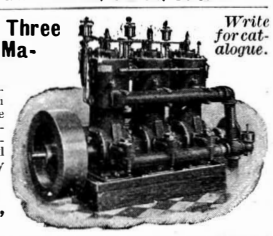

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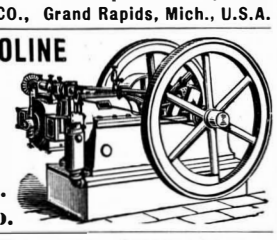

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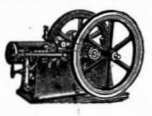

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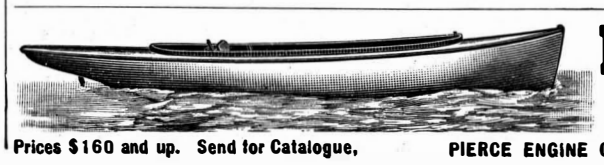

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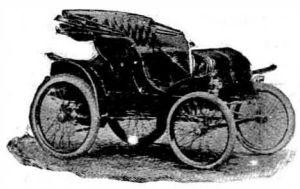

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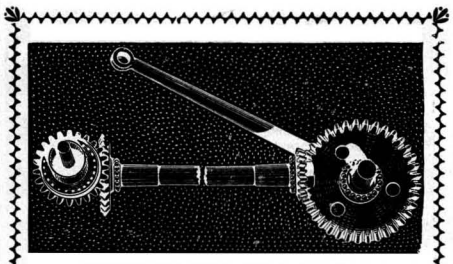

This cut illustrates the chainless mechanism in the 1900

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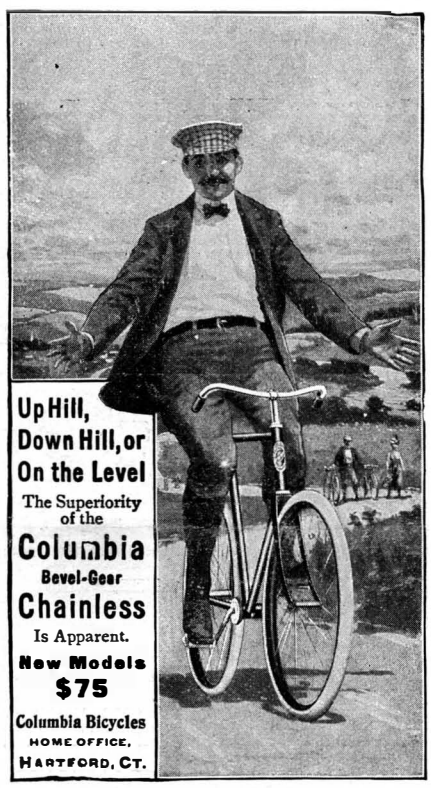

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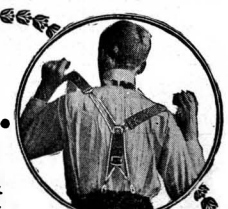

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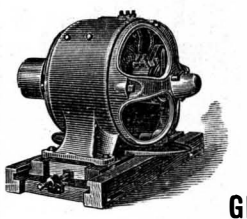

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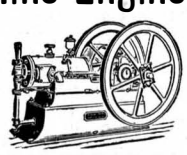

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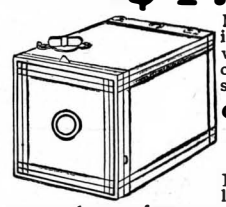

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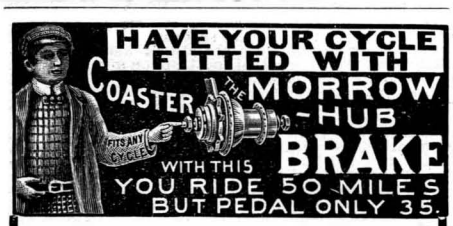


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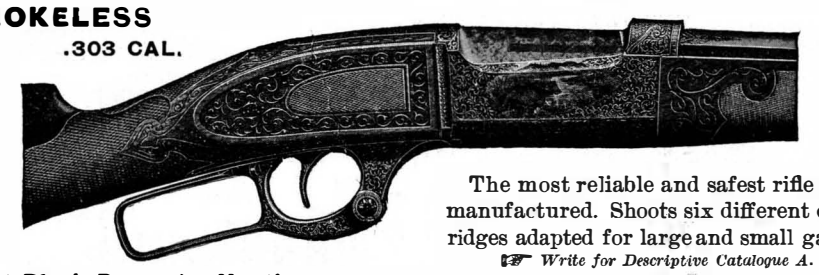

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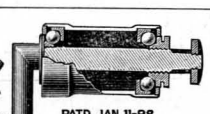


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